AUTOMOTIVE and Aviation INDUSTRIES

APRIL 1, 1945

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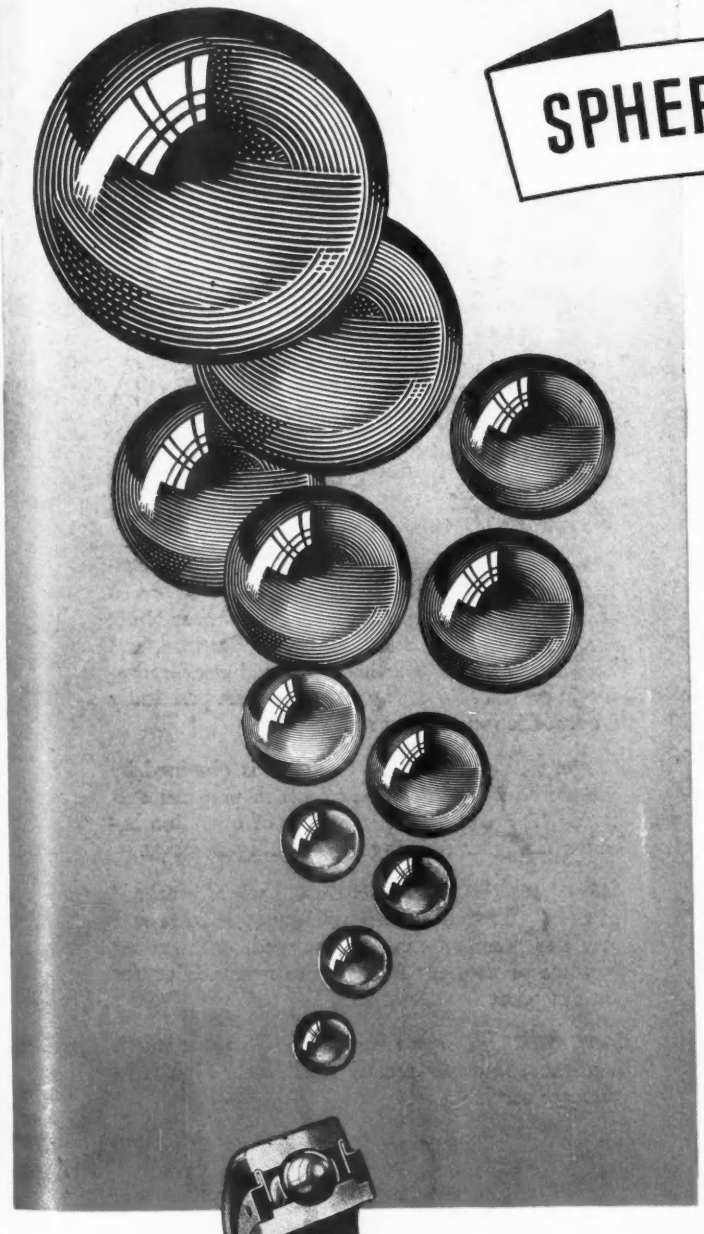

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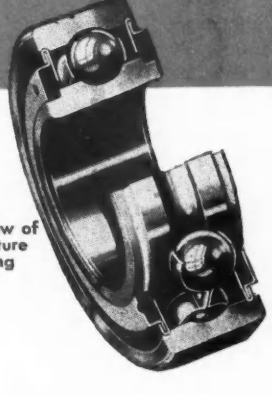

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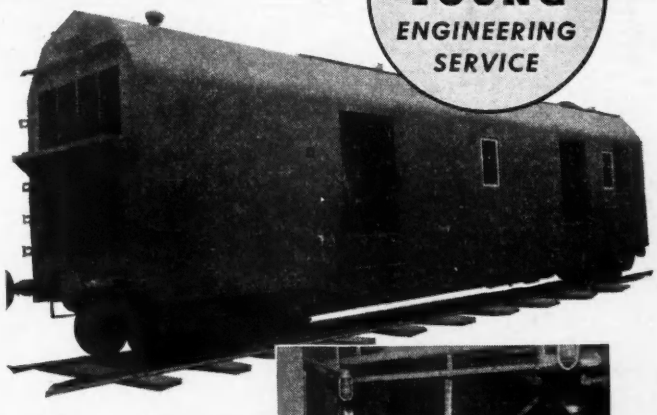

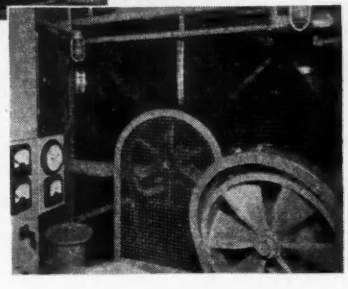

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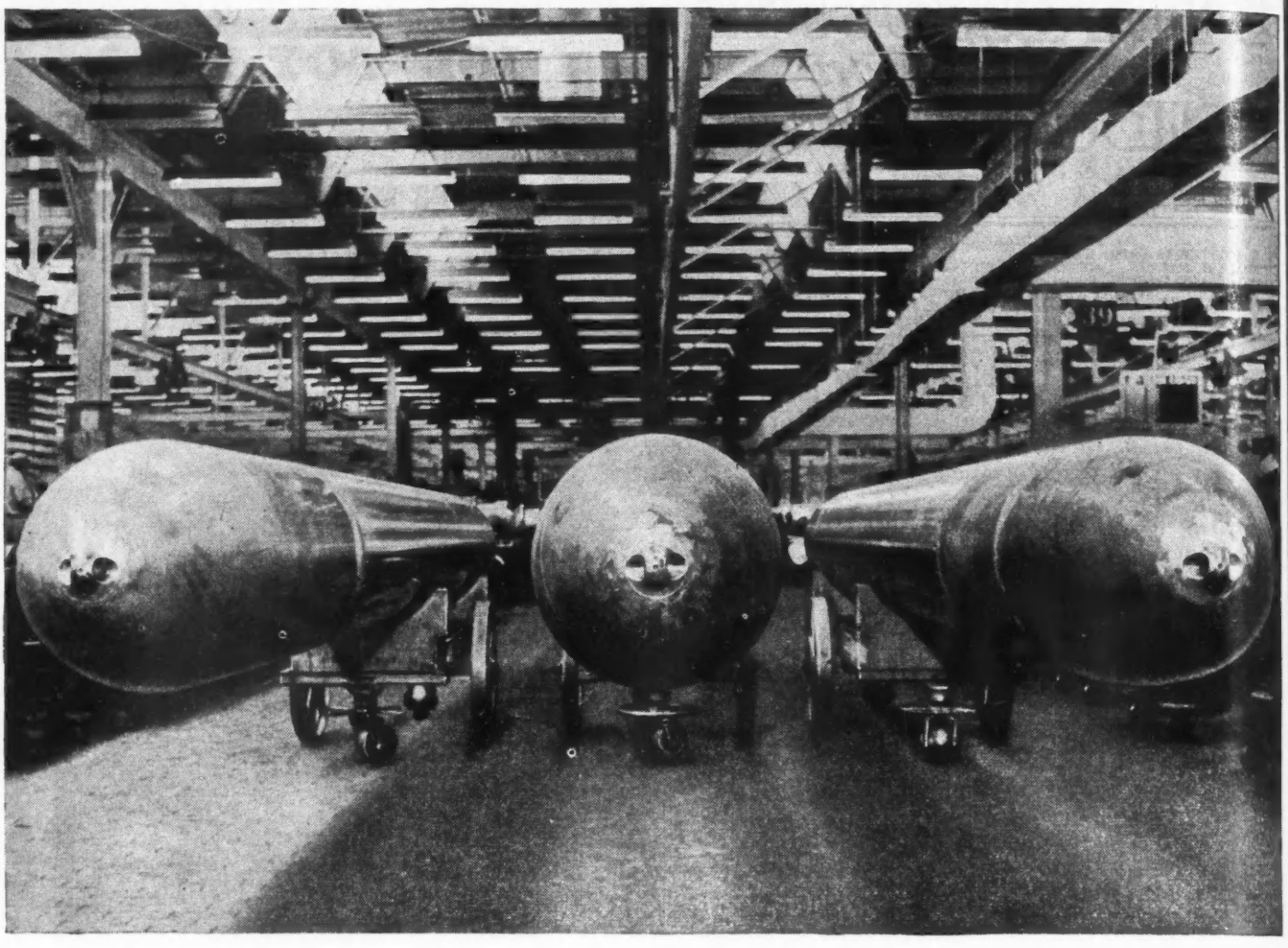

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2. Ordnance Specification P.S. 300-4 contains *official instructions* for the complete processing of such equipment.
3. These instructions require that only rustproofing materials meeting Government specifications be used.
4. *Texaco rustproofing products meet Ordnance specifications for application on Government-owned equipment.*
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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the first and 15th of the month

April 1, 1945
Volume 92, No. 7

Post-War Employment and Reconversion

By Julian Chase

AN ESTIMATE of post-war employment has been developed by the National Association of Manufacturers after a study of 1756 returned questionnaires filled in by members and manufacturing associates in 43 states, less than two per cent of whom have now more than 5000 employees each. The conclusion drawn is that there will be between 14 and 15 million persons employed in manufacturing after the war as against 10.6 million in 1939, or an increase of something more than 30 per cent.

This particular survey, it is pointed out, "is not based upon generalizations as to the future magnitude of the national income or the size of the labor force." It is said, instead, to be founded on what the responding manufacturers regard as reasonable expectations as to their labor requirements measured by what they "can see in their own plants," a consideration of prospective markets, costs and finances, and on "a down to earth estimate of what can be done when reasonably normal competitive business conditions are restored."

A not sufficiently recognized fact that is emphasized by the report is that 61 per cent of these manufacturers will require no time at all for reconversion while 66 per cent of them can be operating on an all-out civilian production basis within four weeks after they get the green light. This shows again the relatively slight extent to which the manufacturing branch of our economy has had to go through the slow and costly business of converting to war production and brings out into a clearer light for fuller comprehension the extraordinary burden that the automotive industry has had to bear and, consequently, will have to bear again during the process of almost complete reconversion. It also makes even more impressive the record of that industry's accomplishments in war production.

After eight weeks, the report goes on to show, 76 per cent of the manufacturers considered and, after 16 weeks, 89 per cent could be running at full-scale post-war production levels. An optimistic view is engendered by this disclosure as it is believed that 16 weeks of unemployment among 89 per cent of the manufacturing industry, calculated on a basis of number of companies, should not require "the opening of the flood gates of public works and relief."

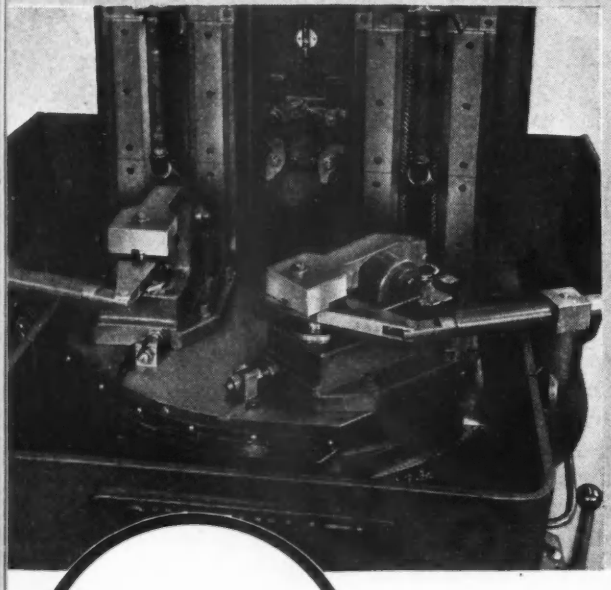
In considering the extent and duration of reconversion unemployment, it is averred, attention has been focused on the toughest problems involved. Among these are those of the automotive industry which will require months and not weeks to get back into shape to turn out its peace-time products at the pre-war rate. But such cases, says the report, "are not typical of manufacturing as a whole." Quite so, perhaps, but—

One of the charts used to present the results of the survey shows the number of workers who will be unemployed more than 30 days due directly to reconversion. The total number of such workers shown is 1,416,000. Of these, 436,000

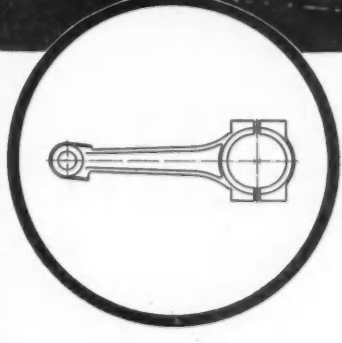
(*Turn to page* 58, *please*)

perhaps you can use this

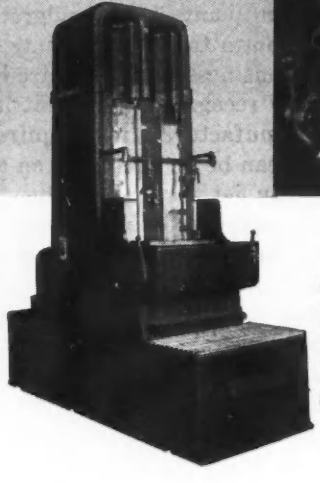
"BROACH-SAW" TECHNIQUE



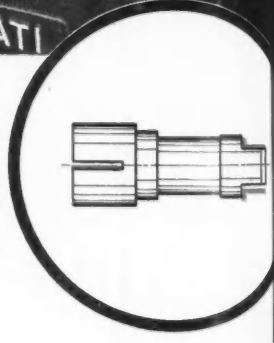
Below — CINCINNATI No. 5-42 Duplex Vertical Hydro-Broach Machine. Complete specifications may be obtained by writing for catalog M-894-2.



Cutters stay sharp about 20 times longer than the former set-up, in the broach cut-off operation illustrated here. The machine is a CINCINNATI No. 5-54 Duplex Vertical Hydro-Broach.



A broach-saw operation, combined with the broaching of other surfaces, handled in the right-hand station of the above machine . . . a CINCINNATI No. 3-48 Duplex Vertical Hydro-Broach. Inserts are good for 25000 to 35000 pieces per sharpening.



Formerly one of the most difficult operations on surface broaching machines, the broaching of narrow saw slots has been perfected by CINCINNATI Application Engineers to the point of a routine production job. Two examples are illustrated here . . . a cut-off operation, and a "broach-saw" job combined with the broaching of other surfaces.

Does this suggest a more economical method in your own shop? Operations of this type on CINCINNATI Hydro-Broach Machines show amazing economies. Remember, too, that *close accuracy* can be maintained; that a *reasonably good finish* will be produced and an excellent finish can be obtained with properly designed tools. Our engineers will be glad to discuss all phases of surface broaching with you, and show you how CINCINNATI Hydro-Broach machines will fit into your production lines.

THE CINCINNATI MILLING MACHINE CO. CINCINNATI, OHIO, U.S.A.

TOOL ROOM AND MANUFACTURING MILLING MACHINES . . . SURFACE BROACHING MACHINES . . . CUTTER SHARPENING MACHINES

Union's Usurpation of Management

and Its Threat to War Effort

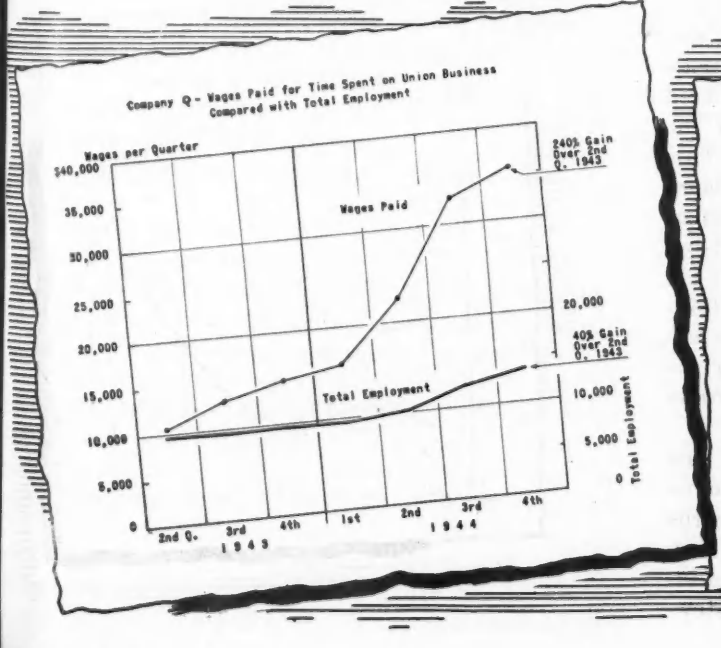
THE Wagner Act itself makes it an unfair labor practice for an employer to extend financial aid to a union. Unquestionably the $7,200,000 paid union representatives by automotive companies last year represented substantial financial aid to unions and, under proper interpretation of the law, would be prohibited. It is our contention and recommendation they should be paid by those to whom they are responsible. Wasted time and manufactured grievances to build up discontent and dissatisfaction among workers could then be expected to decrease. These conditions result from programs and instructions emanating from top union representatives. So, too, do the present distrust and defiance of management, Government, and their own union representatives by a militant minority of workers.

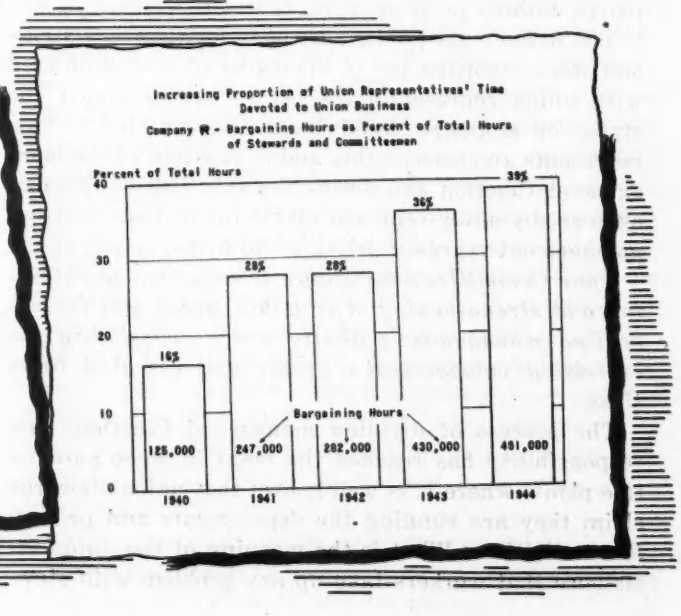
How can union representatives expect the hot-headed minority in their organizations to respect even their authority and the union's responsibility under collective bargaining contracts when they are continuously attacking authority, as such, whether exercised by management or Government?

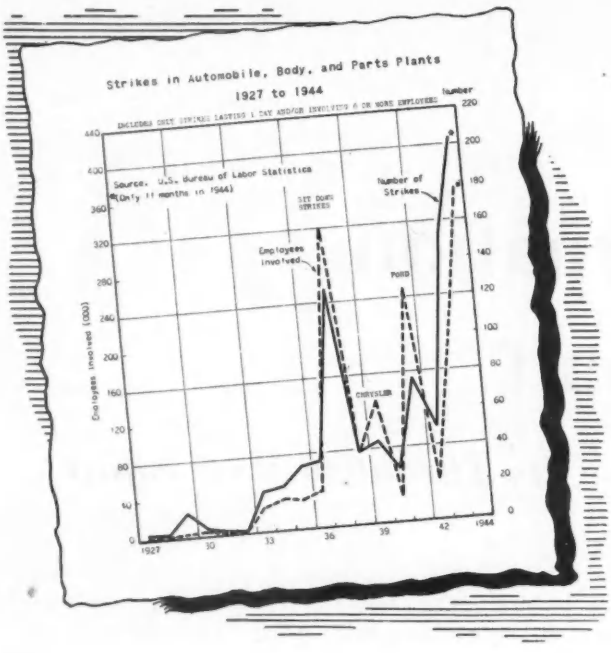
There is evidence of an organized effort to prevent management from exercising the functions it must exercise in order to manage the plants and enable the majority of workers to attain a self-respecting level of usefulness.

There is a well-organized effort to compel union approval before management assigns men to work, to prevent

SUPPLEMENTING the preliminary presentation in our March 1st issue, there is published here a condensed version of parts of the report by George Romney, managing director of the Automotive Council for War Production, submitted to the Senate War Investigating Committee at hearings in Detroit on utilization of manpower. In addition he presented orally and filed with the committee numerous documented case histories and other evidence showing the existence of slowdowns; lost time through late starting, early quitting, and loafing periods; astounding increases in strikes and stoppages; union boasting of reduced productivity, and decreases of 25 to 50 per cent in productivity below prewar standards.







management's transfer of workers in accordance with collective bargaining contracts until the approval of union representatives has been obtained, to prevent management promotion of employes until the approval of union representatives has been obtained, to prevent management from disciplining unruly, disorderly or disobedient employes before the approval of union representatives has been obtained, to prevent the establishment of production standards by management without the prior approval of union representatives, and to prevent management discharge of employes without prior approval of union representatives.

The union's pat public answer to nearly every strike and work stoppage is "if management had conferred with union representatives before taking action the strike or stoppage could have been averted." This represents an emasculation and usurpation of the management function and means the substitution of management-by-union-representatives for management-by-management-representatives or no management at all.

Your Committee's assistance is requested in obtaining and strengthening War Labor Board policies upholding management's ability and responsibility for exercising management's proper and essential functions.

The process of dividing managerial functions and responsibility has reached the point in some automotive plants where it is well known that union stewards claim they are running the departments and production activities. What is the meaning of the union insistence that workers take up any problem with stewards and shop committeemen first? It means just what they said in their official publication. Through this process they have a better chance of putting management under control!

Many interpret public efforts of top union officials to straighten out strikes and stoppages, after they occur, as evidence that they were not involved in creating present conditions. Why has this decline in productivity—this widespread and organized challenge of the exercise of essential management functions—developed? It was nurtured and brought into being before the war.

Since the fall of 1940, an objective of the United Automobile Workers of America, CIO, has been, in their own words, to "obtain a voice in management." This means usurpation of at least part of the management function, authority and responsibility. Their pursuit of this objective has been itensified during the war.

The lack of productivity in automotive plants—the inability of these plants and of most of the people in them to produce the weapons they are capable of producing—results primarily from the continuation of the selfish drive of union representatives for more, and more, and more power — political, economic and social.

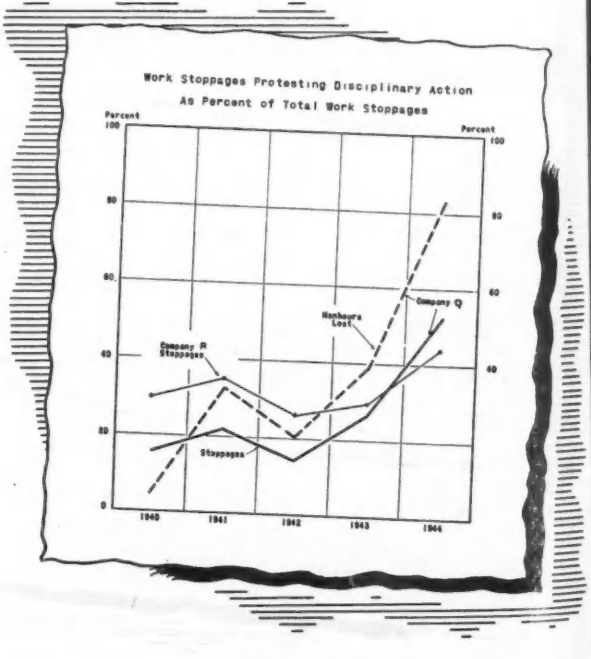
The first drive to obtain division of the management responsibility was centered in what came to be called the "Reuther Plan." It was developed and promoted by leaders of UAW-CIO through the fall and winter of 1940. It was introduced informally in December, 1940, as "a program for the utilization of

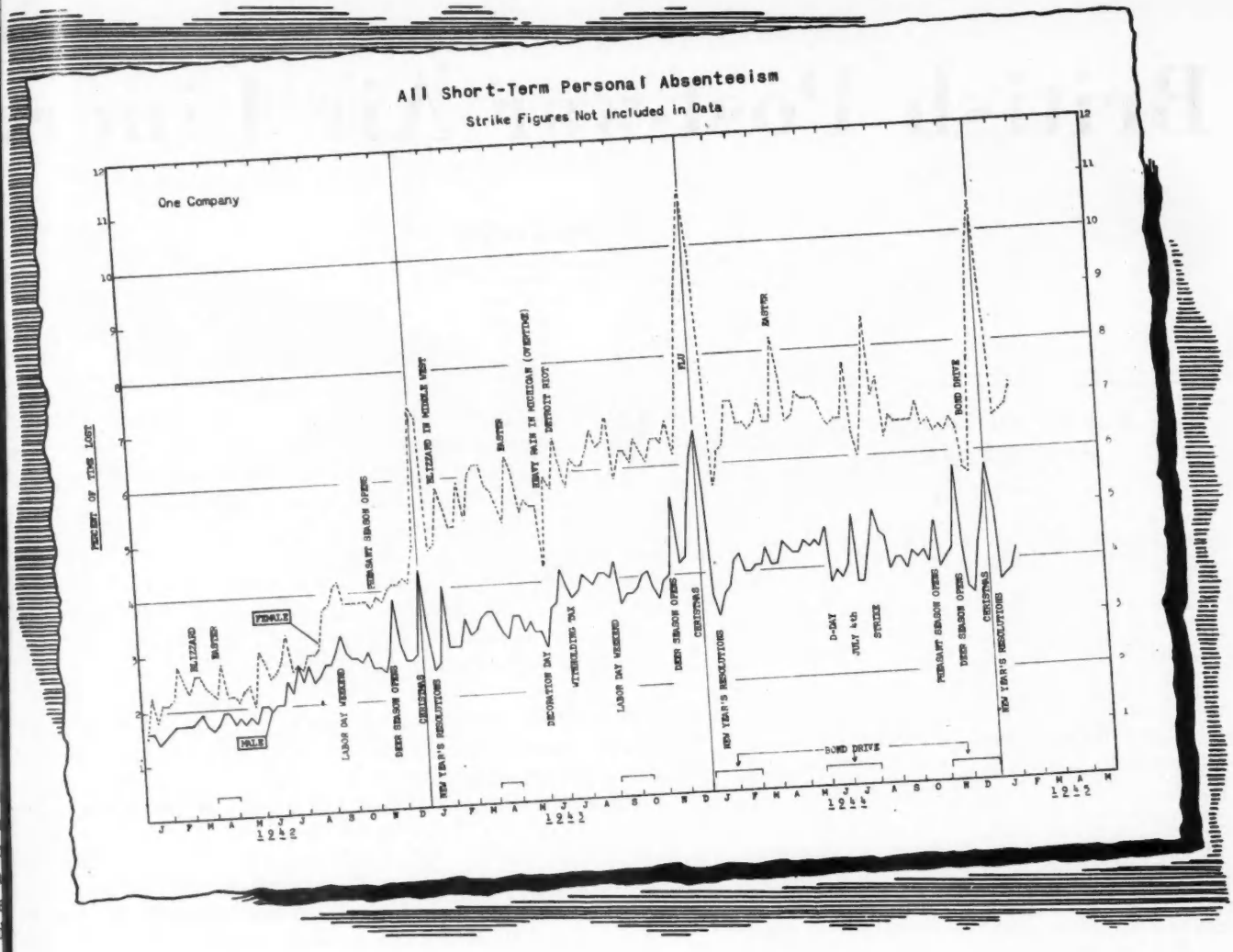
Absenteeism in Automotive Plants

	Percent of Employes Absent	
Month	1943	1944
January	...	5.1
February	...	6.0
March	...	5.9
April	...	6.2
May	4.7	6.2
June	5.2	5.8
July	5.9	6.2
August	6.4	6.7
September	5.4	5.5
October	5.8	5.5
November	6.0	5.8
December	9.5*	5.6

*High rate due to influenza epidemic.

Source: Based on reports to U. S. Bureau of Labor Statistics by over 400 automotive





the automobile industry for the mass production of defense planes."

It proposed a tri-partite production or management board, with members to be appointed by the President, with "full authority to organize and supervise the mass production of airplanes in the automobile and automotive parts industry." It disregarded actual steps already taken by the industry to convert facilities to the production of the types of aircraft equipment the President, General Arnold and General Knudsen had determined were required.

Union cooperation with the tri-partite board depended on a union "voice in matters of policy and administration, recognition of its rights and maintenance of its established standards."

This audacious scheme, based on technical misinformation, engineering fallacies and a total disregard for the facts of the Government's procurement policy and determined use of industry facilities for aircraft production, obtained wide public acceptance before its real implications were understood.

The principal objective of the CIO postwar plan drive is usurpation of the responsibility and functions of management. Stripped to its essentials, it is simply another proposal for Government creation of a union-management-Government board which would be responsible for "taking the country through reconversion and managing peacetime production."

Separate union-management-Government councils would be established for each industry. The automotive council would divide management responsibilities between union representatives, Government representatives and management representatives. It would determine and impose plans for investing in new plants, machinery and equipment, production and employment, production rates, new products, transition and postwar wage rates. These objectives are far afield from the legitimate objectives of collective bargaining, which relate to questions of recognition, wages, hours, and working conditions.

Let's assume the union's real objective—to usurp management responsibility or obtain a "voice in management"—succeeds and union representatives are designated on industry councils, on an automotive industry council. We shall then have permitted, through the back door, that seizure of power by unions or by other groups which the American people have resisted through the front door from the very beginnings of our Nation. The union representatives in automobile company managements shall then have effected an interlocking management relationship capable of controlling production, prices and other competitive matters in a manner more monopolistic and predatory than

(*Turn to page* 54, *please*)

British Post-war Air Liners

By M. W. Bourdon
Special Correspondent of
AUTOMOTIVE *and* AVIATION
INDUSTRIES in Great Britain

Major Specifications of Bristol Freighter

Dimensions

Wing span	98 ft.
Overall length	68 ft. 4 in.
Overall height (over fin)	21 ft. 8 in.
Wing area	1405 sq. ft.
Aspect ratio	6.84 to 1
Volume main cargo hold	2020 cu. ft.
Volume rear cargo hold	340 cu. ft.
Main cargo hold—31 ft. 8 in. long, 8 ft. wide (at 24 in. above floor), 6 ft. 8 in. high (minimum).	
Wheel tread	27 ft. 6 in.

Weights and Loadings

Gross weight	30,000 lb.
Empty weight	18,455 lb.
Crew (two)	400 lb.
Disposal load	11,145 lb.
Power loading (TO power)	12.8 lb./bhp.
Wing loading	21.3 lb./sq. ft.

Performance

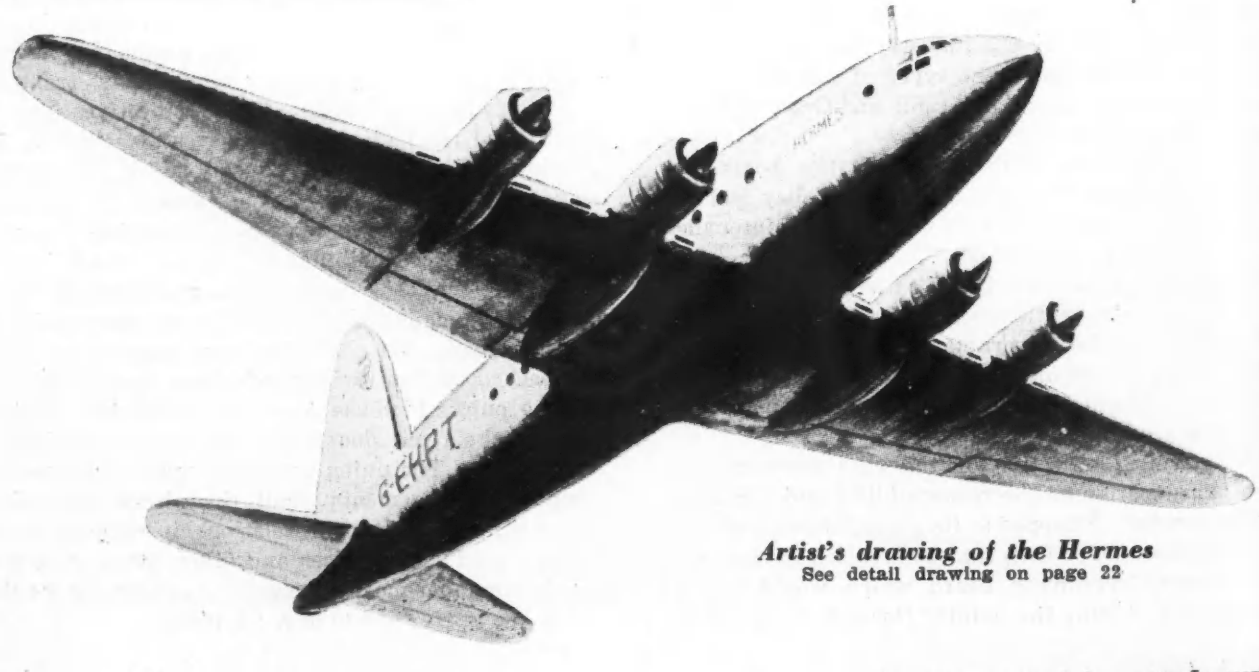
Cruising speeds:	
500 bhp. per engine (42% TO power)	144 mph.
600 bhp. per engine (51% TO power)	158 mph.
700 BHP per engine (60% TO power)	170 mph.
Stalling speed	67 mph.
Service ceiling	16,000 ft.
Initial rate of climb	900 fpm.
Take-off to clear 50 ft.:	
Concrete runway	650 yd.
Grass runway	700 yd.
Landing over 50 ft. (at 27,500 lb.)	760 yd.
Cruising range (standard tanks)	1400 mi.
Cruising height	5000 ft.

WHEN they are permitted to switch over from the all-out production of military machines to the production of aircraft for civilian services British aircraft manufacturers will have in readiness a wide variety of types for the transport of passengers or freight, or both; some of these are now in production for employment on essential war services, while others are either planned or under construction as prototypes. The British Society of Aircraft Constructors has issued a memorandum on this subject, and the following information is derived from it and other sources.

Miles M.60

The latest addition to the civil aircraft to be announced is the Miles M. 60, an all-metal monoplane of medium size, with a capacity for 14 passengers and a crew of two. It will have four de Haviland Gipsy Queen air-cooled, in-line supercharged engines with a cruising output of 360 hp each. Its normal fuel capacity range will be about 1000 miles and its cruising speed around 200 mph. A pressurized cabin will be provided, if required. Design is said to have reached an advanced stage and it is estimated that the first trial flights will be made before the end of this year. It will be offered for use in feeder-line and air taxi services in any part of the world.

The Miles M. 60 fills a gap in the British civil aircraft program and conforms with the requirements of Type 5 specified by the Brabazon Committee charged with advising what types of civil aircraft the Government should encourage manu-



Artist's drawing of the Hermes
See detail drawing on page 22

and Freighters

The Lancastrian, civil version of the RAF Lancaster bomber, for service on the Britain-Australia route (British Combine photo).

facturers to prepare in readiness for production as soon as possible. The Ministry of Aircraft Production has already ordered a number of M. 60s in advance of trial flights.

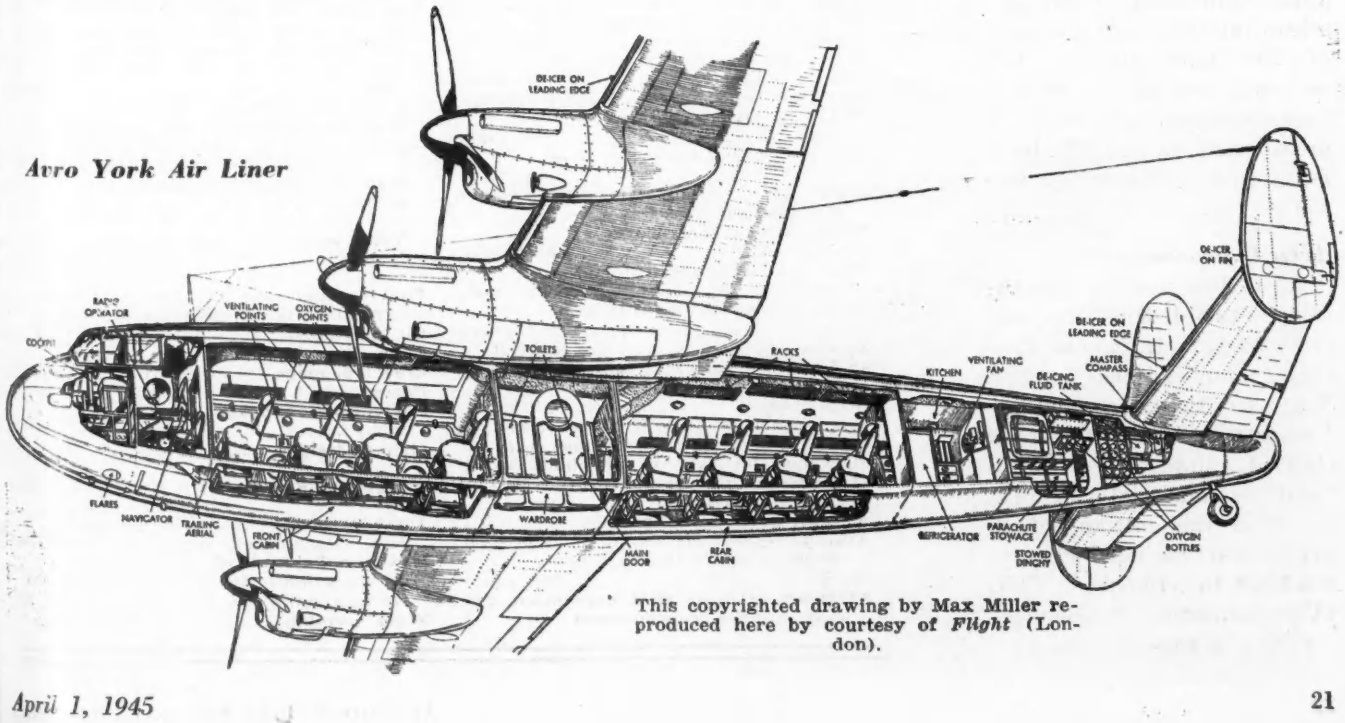
Bristol Freighter

Another civilian aircraft of which preliminary particulars only have been released is the Bristol "Freighter," some details of which appeared in AUTOMOTIVE AND AVIATION INDUSTRIES of Feb. 1. Operating economy looms large in the aims of its designers, the Bristol Aeroplane Co., and it is computed that its operating costs will be approximately one shilling per long ton-mile. The gross loaded weight will be 30,000 lb and the range 300 miles with a payload of 9000 lb. Two Bristol Perseus sleeve valve, nine cylinder, air-cooled radial engines, rated at 1175 hp each for take-off, will be used initially, but may be displaced in later designs by another (unspecified) type of greater power. Specifications of the Bristol Freighter are listed in the accompanying table.

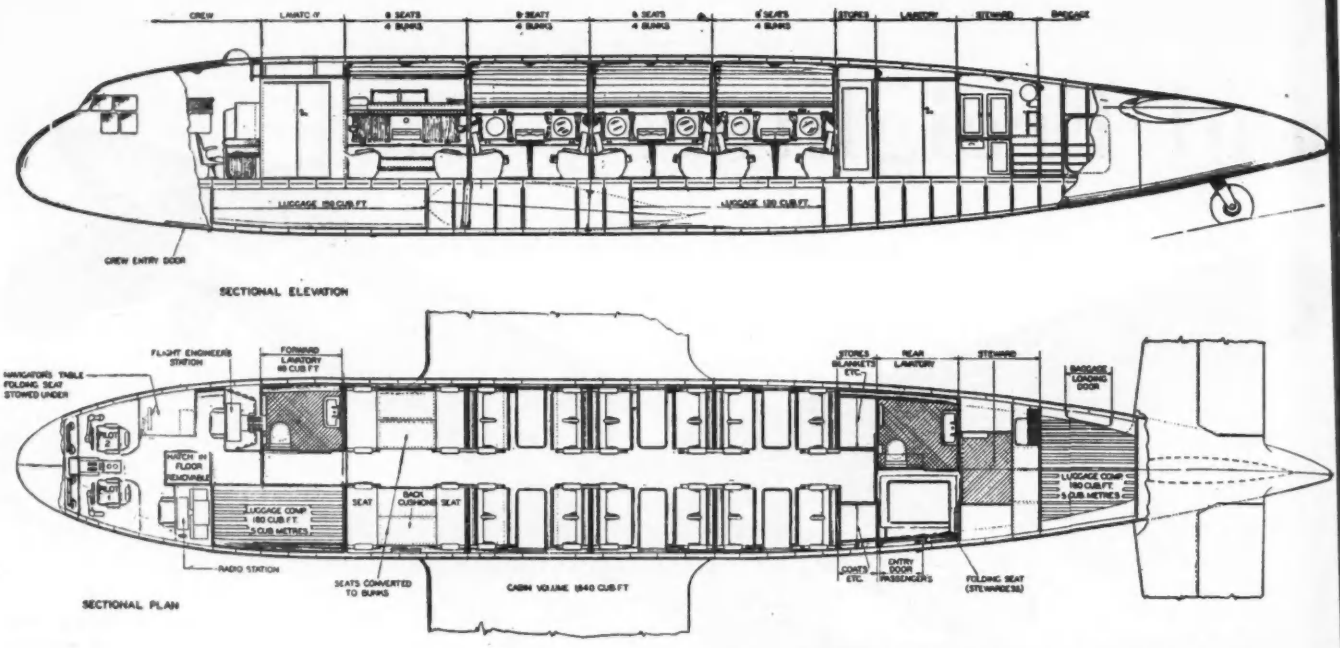
Bristol Brabazon

In addition to the Freighter, the Bristol Aeroplane Co. is said to be "forging ahead with design and development" on a Brabazon Committee Type 1 aircraft, but no particulars have been released beyond the fact that it will carry up to 50 passengers plus 5000 lb of mail or express and has a cruising speed with that load of 250 mph.

Avro York Air Liner



This copyrighted drawing by Max Miller reproduced here by courtesy of *Flight* (London).



These drawings show the interior arrangement of the Hermes sleeper version for 16 passengers at night or 32 passengers by day. The day seats are easily converted into the lower berths while the upper berths pull down from the cabin roof where they are stored for day travel. Day transport versions of the Hermes provide seat arrangements for 20, 34 and 50 passengers. Drawings reproduced by courtesy of* Flight, *London.

Handley Page Hermes

The Handley Page Co., manufacturers of the Halifax four-engined bomber, also have a Brabazon Type 1 aircraft under development. There are two versions, one for passengers and the other for freight. Known as the Hermes, it is said to be approaching its final construction stage. With four Bristol Hercules 14-cylinder sleeve valve radial engines giving a maximum output of 6600 hp, it will have gross weight of 70,000 lb and a capacity for either 50 passengers or 16,000 lb of freight. An all-metal monoplane, it is designed for a maximum speed of 340 mph, a lean mixture cruising speed of 290 mph and a fuel-economy cruising speed over long distances of 240 mph. A pressurized cabin will be a feature of the passenger version.

Avro Lancastrian

A. V. Roe and Co. has developed two distinct civil aircraft from their famous Lancaster four-engined bomber. They are the York and the Lancastrian. The latter is not claimed, however, to be a "real" commercial aircraft, for it is the outcome of an urgent wartime demand for a machine to transport VIDs (Very Important Personages)

(*Turn to page 72, please*)

Performance, Dimensions, Weights of Avro Lancastrian

Dimensions

Length overall .....76.8 ft.
Height overall .....19.5 ft.
Wing Span ..... 102 ft.
Wing Area (gross).....1297 sq. ft.

Performance with four Rolls Royce Merlin Engines

SPEED—Maximum all-out level speed at mean weight of 53,000 lb.:
With medium supercharge at 3500 ft. .....295 mph.
With full supercharge at 12,000 ft. .....310 mph.
Maximum weak mixture cruising speed:
With medium supercharge at 11,000 ft. .....275 mph.
With full supercharge at 17,500 ft. .....285 mph.
CLIMB—Rate of climb at maximum weight of 65,000 lb.:
With medium supercharge at sea level .....750 ft./min.
With medium supercharge at 9500 ft. .....750 ft./min.
With full supercharge at 16,000 ft. .....550 ft./min.
Service ceiling .....23,000 ft.
TAKE OFF—Under still air conditions at 65,000 lb.:
Ground run ..... 800 yd.
From rest to clear 50 ft. screen..1200 yd.
RANGE—Under still air conditions, with no allowance for take-off or climb, using 3174 Imp. gal. of fuel and carrying 3600 lb. payload, at 15,000 ft.:
At Most Economical Speed
Average speed 200 mph., average fuel consumption 152 Imp. gal./hr.
Range .....4150 miles
At speed between most economical and weak mixture cruising speed
Average speed 232 mph., average fuel consumption 186 Imp. gal./hr.
Range .....3950 miles
At maximum weak mixture cruising speed
Average speed 265 mph., average fuel consumption 236 Imp. gal./hr.
Range .....3570 miles

Weight Data

Empty Weight	30,426 lb.
Fixed and removable equipment, including electrical, instruments, auto-controls, radio, de-icing, dinghies, heating and ventilation and oxygen	4160 lb.
Furnishings, including bunks, settees, mattresses, toilets, upholstery, carpets, soundproofing, kitchen food and water (bedding at 20 lb. per passenger not included)	1564 lb.
Total weight equipped and furnished	36,150 lb.
Fuel in wing tanks (2154 Imp.gal.)	15,509
in fuselage tanks (1020 Imp.gal.)	7344
Oil (150 gal.)	1350
Crew (5 at 170 lb. each)	850
Crew's baggage (40 lb. each)	200
Passengers (9 at 170 lb. each)	1530
Passengers' baggage (at 55 lb. each)	495
Mail or freight	1572
Gross Weight	65,000 lb.
Total Payload (Passengers, passengers' baggage and cargo)	3597 lb.
Maximum Payload (with corresponding reduction in fuel carried, about 175 Imp. gal.)	4845 lb.
Wing Loading	50.10 lb./sq. ft.

Centerless Grinding of Screw Threads

By James R. Custer

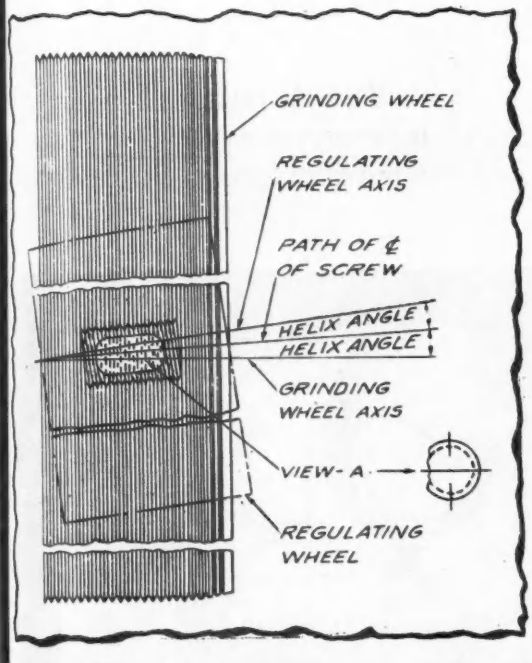


Fig. 1—Schematic drawing showing relation of grinding wheel, regulating wheel and path of screw blank

IT IS generally recognized that modern machine tools have made a major contribution to the unprecedented output of mechanical equipment during the war and accompanying this achievement is the tremendous volume of screw threads. This latter record has been accomplished with improved machines using threading systems that have been in existence for years, such as cutting by chasers or dies, milling, forming by rolling, or by grinding with single-edged or multiridged grinding wheels. To these has been added a new grinding method.

Since centerless grinding provides an unusually rapid and accurate method of finishing cylindrical surfaces, there are inherent possibilities of adapting this technique to screw threads. Development work toward that goal was started at the beginning of 1943 by the Landis Tool Co. and it was discovered immediately that many difficult problems lay ahead. Now after more than two years of experimental investigation and testing in actual production setups, Landis Tool engineers are confident that the centerless thread grinding method is ready for commercial application and the company has announced details of the machine that has been developed for that purpose. The engineering highlights of this new development are presented in this article because of the general interest in thread forming at automotive and aviation plants. A description of the Landis Tool Centerless Thread Grinder will be found in the New Production Equipment section of this issue of AUTOMOTIVE *and* AVIATION INDUSTRIES.

In its present state of development, centerless grinding is being applied in production to thread in one pass hardened socket set screw blanks in sizes from 0.112 in.-40 pitch (No. 4) to ⅝ in.-11 pitch. For a short run with ¼-20 screws, ½ in. long, the rate is 3600 to 4200 screws per hour. Using an automatic loader, the hourly rate can be increased to 5200. On a basis of operating continuously through an eight-hour period that does not require regrooving of the grinding wheel, the total output for the eight hours amounts to 12,000 to 16,000 screws.

Screws 12 in. long of ¼-20 size have been ground in one pass and 1 in.-8 pitch screws 6 in. long in two passes. Hardened steel rings of 5 in. diam also have been ground with 16 pitch threads in two passes. It is pointed out that centerless grinding of threads can be done on solid steel stock in either the hardened or annealed condition.

The centerless thread grinding system as developed by Landis Tool engineers requires special settings of the grinding wheel, regulating wheel, and the work rest blade to take care of the different screw diameters, thread pitch, and rates of feed. The grinding wheel can be moved laterally to increase or decrease the throat between it and the regulating wheel, an adjust-

(*Turn to page* 108, *please*)

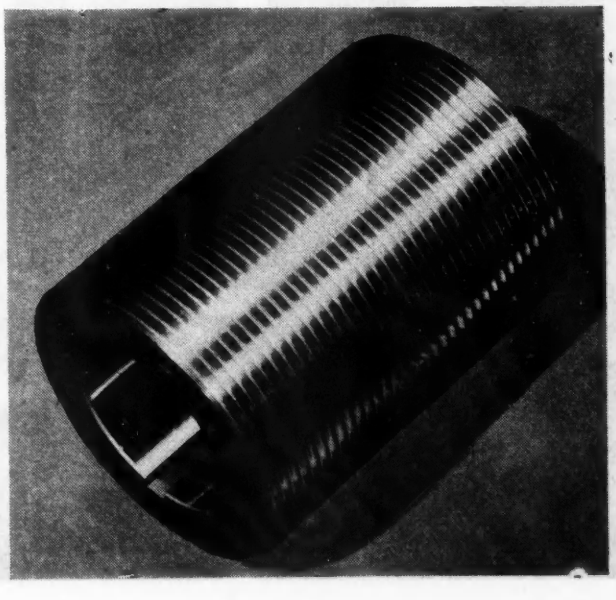


Fig. 2—Crusher for 1-in. diam, 8-pitch screws

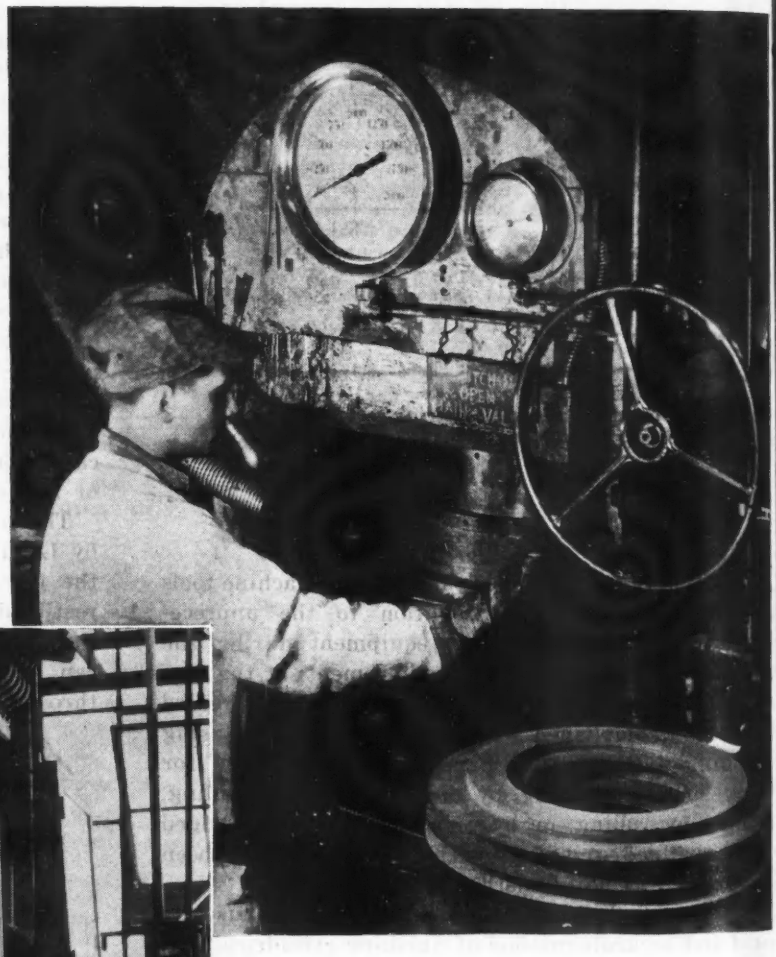
Clutch Facings and Brake Linings of

Powdered M

This is the 104th in the series of monthly production features

ONE man's vision and determination to provide industry with an entirely new type of friction material have borne fruit in an important contribution to the war. More than 12 years ago, S. K. Wellman, founder of The S. K. Wellman Co., Cleveland, Ohio, began his work on all-metal clutch facings and brake linings, turning to the then relatively new powder metallurgy which has created an amazing industry with many ramifications familiar to chemists and engineers in many industrial fields.

Today this organization is said to be one of the largest producers of metal facings for clutches and brakes, supplying the armed forces with materials that make possible exceptional performance and life. Wellman facings are used in the brakes and superchargers of military airplanes, for the clutches of tanks, amphibious craft and earth-moving equipment, all operating under conditions beyond the range of the most severe service expected of heavy duty automotive units. Other applications include replacement and original equipment clutch facings and brake linings for a widely diversified list of industrial machinery,

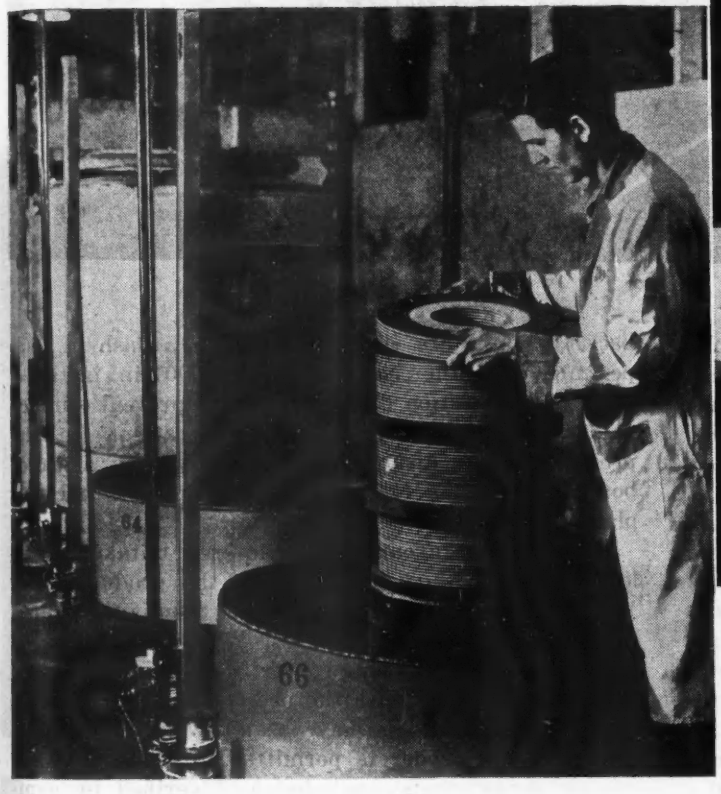


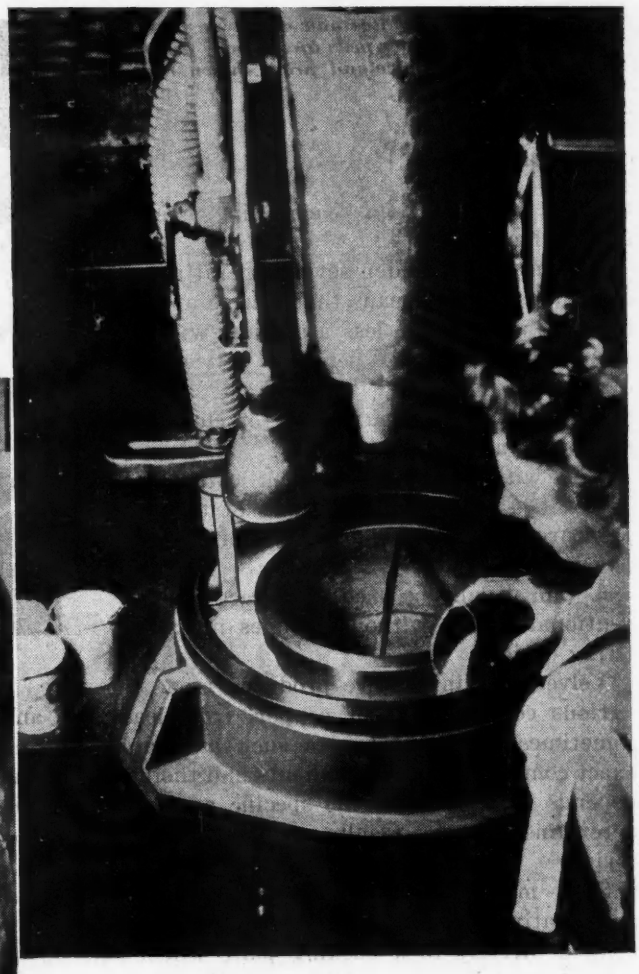
(Above) Powerful hydraulic presses of special design are used to compress the powdered metal into green which must be handled carefully until their physical properties are fully developed by sintering.

(Left) The "Cores" and backing plates are electroplated in this automatic plating machine to provide a firm bond for the friction material in sintering.

By Joseph Geschelin

Metal Type





(Above) In preparation for pressing, the metallic powder mixture is poured into the spinning die and is spread evenly to about the form of the finished product.

(Left) The compacts now are placed upon the steel backing plates and stacked up as shown in preparation for sintering in the electrical furnace. This treatment not only sinters the metal but bonds the friction material to the steel plate.

earth-moving equipment, heavy-duty trucks and trailers, marine units, etc.

Background for this progress is an extensive research program leading to the development of powdered metal mixtures, and of unique fabricating procedures stemming from Mr. Wellman's pioneering work. A trip through the large plant shows, even on casual observation, that most of the special equipment used here has been designed and built by the organization. And this extends even to the molding presses and the special electric furnaces used for the sintering operations.

The S. K. Wellman Co. boasts one of the most comprehensive laboratories to be found in this field. Here will be found chemical laboratories which carry on the work of experimentation with powdered metal mixtures and with plating procedures. The mechanical laboratories feature some outstanding dynamometer equipment, the largest of which is an enormous machine for testing heavy-duty truck and airplane brakes. This dynamometer, built by the Adamson Machinery Co., is equipped with a special panel board and automatic controls for a cycle of operation simulating actual airplane landing conditions. It has a huge flywheel with adjustable weight up to 19 tons, providing kinetic energy as high as 10 million ft-lb.

Other dynamometers are available for testing various types of industrial clutches, light truck brakes, etc. A special dynamometer setup has been developed for testing Velvetouch clutch discs used in automatic transmissions. Still another specialized machine is an intricately controlled dynamometer for testing supercharger clutches. It is capable of attaining speeds of over 18,000 rpm., being driven by an air turbine.

Among the unique advantages of all-metal friction linings, according to the manufacturer, are the following:

1. Satisfactory performance at temperatures and unit pressures greatly exceeding those of conventional materials. Temperatures of 1000 F and pressures up

Steel backing plates and disk-type facing "cores" are stamped on punch presses such as the Cleveland press shown here.

to 1000 psi have been reached in some applications.

2. Longer life under severe operating conditions. This means that brakes and clutches will require less attention, with considerable longer periods between overhauls.

3. The effect of oil and water on clutch and brake action is minimized.

4. It withstands severe shock loads.

5. Little affected by extremes of temperature or by variations in atmospheric humidity.

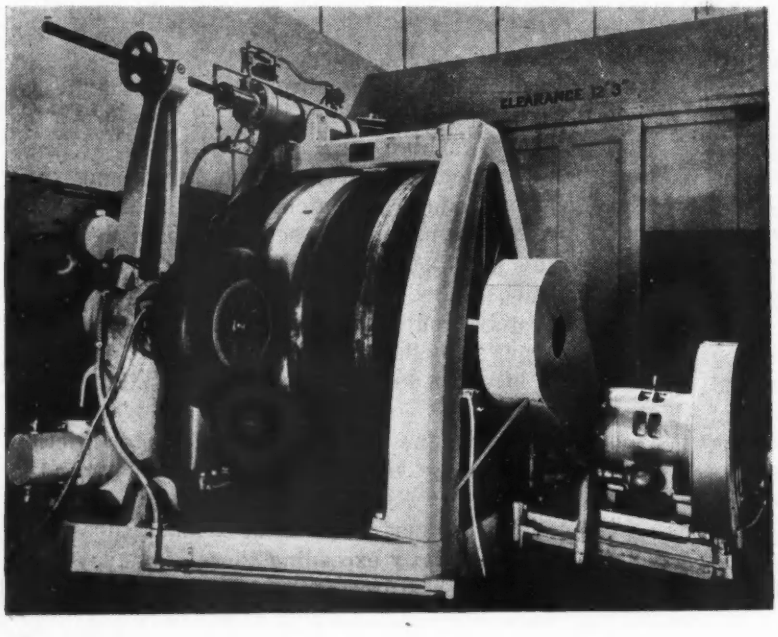
6. Can usually be used to replace conventional linings without changes in existing designs.

Velvetouch linings are produced from various combinations of copper, iron, lead, tin, and sometimes other substances such as graphite. The exact combination of ingredients and their proportions depends entirely upon the specific application and is determined by the results of research in the laboratories.

Since most friction plates are of thin sections and are relatively weak in tension and shear, they are bonded directly to a backing plate which may be of steel, copper, bronze, cast iron, or other metal, depending upon the design of the mechanism. It may be noted at this point that one of the principal differences between conventional powder metallurgy and that of friction materials is this feature of bonding of the friction material to a backing plate, which is accomplished simultaneously with the sintering operation. Just prior to the bonding process, the surfaces of the backing plates are electroplated with a flash of copper, nickel or other material about 0.0001 in. in thickness. The function of this film is to prevent surface oxidation during the sintering operation. In the process the film disappears, thus permitting a direct bond between the friction material and the backing plate.

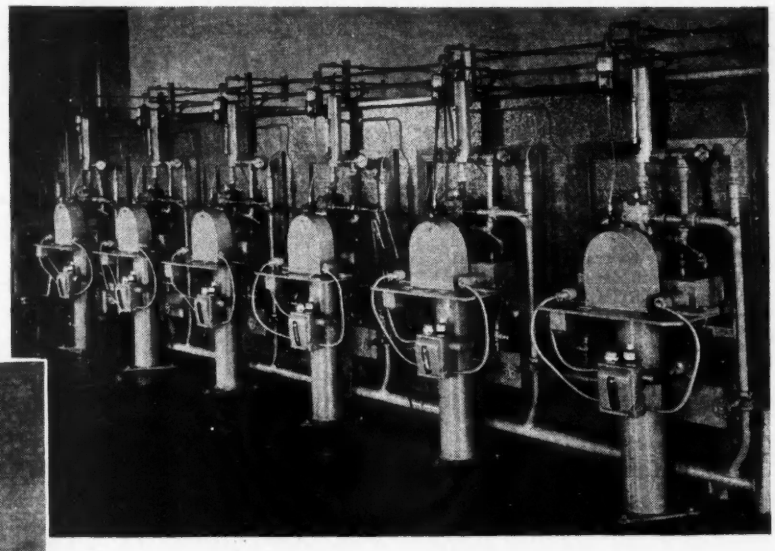
With this background it is of interest to take a brief look at the methods employed in the production of Velvetouch friction lining. The first step is the preparation of the powder mixtures. These are prepared in the mixing room, being carefully weighed in batches on precision scales. At the present time, more than 800 different mixtures have been developed. Before the prepared powder is permitted to go to the production departments, each batch is verified by sampling in the laboratory.

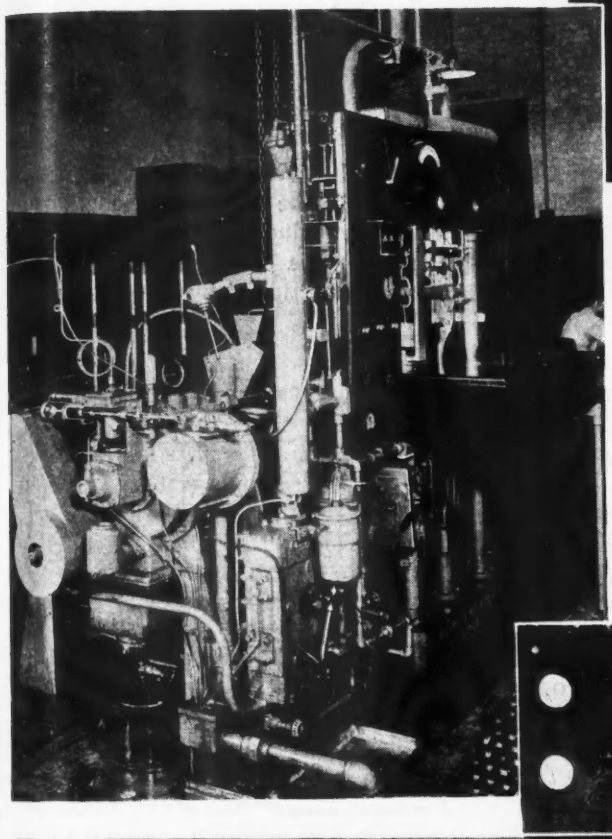
The powder mixture then is transported to weighing benches, where the proper amount of ingredient for one lining or segment is weighed out on precision scales and transferred into a unit part container. For the next stage, the unit parts containers go to special machines in which the charge is dumped into a mold or die, deposited onto a steel separator ring, and smoothed off to the proper thickness by a distributing arm which sweeps over the mold while the latter is rotated. Successive layers of powder are thus produced, each layer being separated from the other by a steel separator. (*Turn to page* 85, *please*)



Enormous dynamometer, shown here, is used for testing airplane and heavy duty truck brakes equipped with Wellman linings. It has a seven-foot diameter flywheel, capable of developing kinetic energy upwards of 10 million ft.-lb. and permits of surface speeds equivalent to 125 mph.

(Right) Complete facilities for research testing of engine fuels and lubricants are provided in the new Automotive Laboratory of the Sun Oil Co. at Marcus Hook, Pa., which at present is concentrating on military projects. Some views of sections in the laboratory, from which military restrictions were removed recently, are shown on this page, but details of the latest equipment for testing aviation gasoline and oils cannot be disclosed due to security reasons. In the photo at the right is the battery of Lauson single cylinder engines for preliminary engine oil tests.

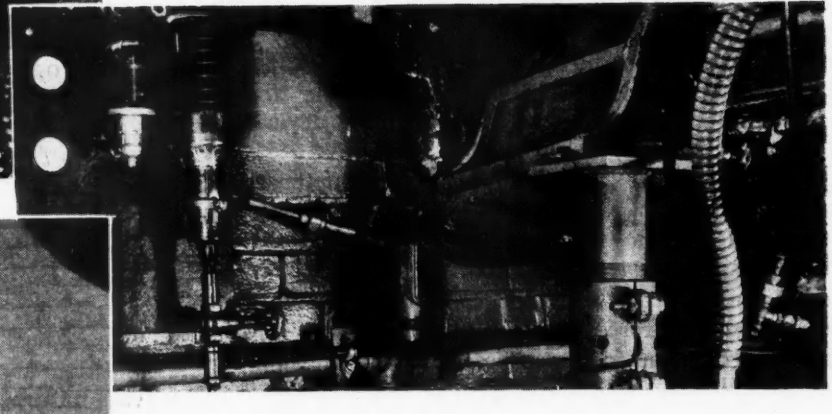


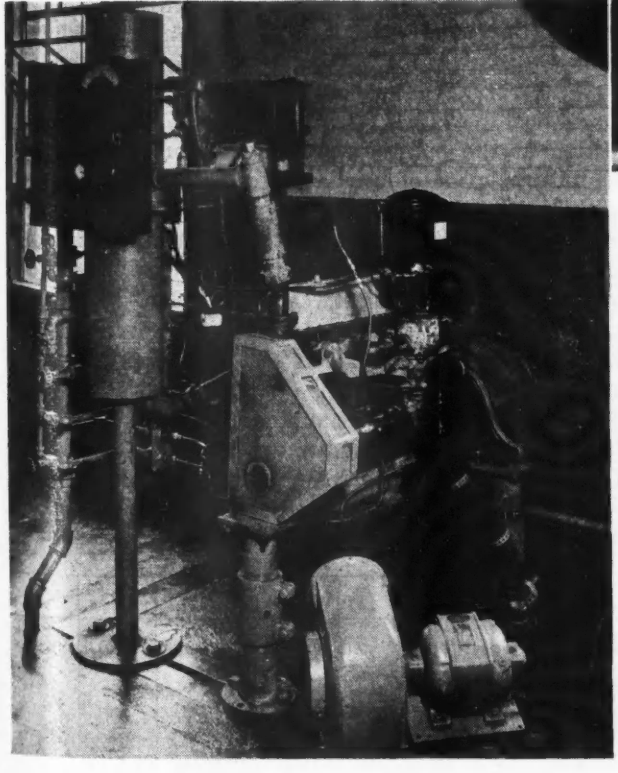


Sun's New

Automotive Laboratory

(Left) One of the three double-ended dynamometers at the Sun Laboratory. This unit is used for Diesel testing.





(Above) Among the time and labor saving devices developed by the laboratory engineers is this system for maintaining constant oil level in the crankcase of multi-cylinder test engines. The large bottle supplys oil to the crankcase and it is graduated so that the consumption can be observed while the engine is running. The small bottle at the left feeds lubricants to the bearings of the dynamometer fan located in a sound-proofed housing outside the building.

(Left) Equipment includes a battery of dynamometers of the fan absorption type for routine testing of oil in multi-cylinder engines. The blower in this photo, which shows one of the test stand setups, is used for controlling crankcase temperature. The laboratory building also has a test car shop where automotive vehicles are checked and equipped with instruments for road testing of either fuels or lubricants. After tests engines are reconditioned in the main machine shop.

Determination of Crankshaft S

This article translated from Automobiltechnische Zeitschrift. Courtesy of British Ministry of Aircraft Production.

IT IS a familiar fact that the amplitude of vibration of an oscillatory system is greatly increased when a critical speed is being passed through. This increase is measured by the so-called "amplification factor," that is, the multiplier which must be applied to the static deflection of an oscillatory system assumed to be fixed at one node, to obtain the maximum deflection in the critical-speed region for the corresponding harmonic. As may be seen from Fig. 1, the amplification factor, which most frequently has a value of 10, can attain a value as high as 60 under certain conditions, but, of course, only in systems without external damping. If an effective vibration damper is used, the amplification can be held down to about five times the static deflection; and exceptionally, under most favorable conditions, to a little as 2½ or 3 times, provided the damping device is designed for maximum effect irrespective of dimensions, weight, or cost. An essential condition, however, is that the tuning ratio—i. e., the ratio of the natural torsional frequency of the crankshaft (the primary system) to the frequency of the damping device (the secondary system) is favorable.

The curve Fig. 2 shows the variation in the amplification factor with the optimum tuning ratio determined by the ratio of the system masses: m_2 (secondary or damping system) and $_1$ (primary or oscillating system), for the case of a constant harmonic exciting force P, $\sin \omega t$. It will be seen that for an amplification factor of less than 3, the damping mass should not be less than one-third of the mass of the oscillatory system.

On the other hand, the relative magnitude of the supplementary stresses in the critical regions can be evaluated from the known values of the exciting forces, by vector addition. To this end, the exciting force acting on each crank is multiplied by the relative deflection at the point of application corresponding to the natural mode of oscillation of the system, divided by the initial deflection in the system, and the resulting vectors are added together according to magnitude and direction, the direction in each case being the product of the angle between crank No. 6 and the crank in question, and the order of the corresponding critical oscillation. This can best be explained by the following example:

Fig. 3 shows the crank arrangement and Fig. 4 the distribution of masses and natural mode of oscillation of a six-cylinder, four-stroke engine crankshaft. Fig. 5 is the vector diagram of the 5½ order harmonic. The corresponding angles and vectors are as follows:

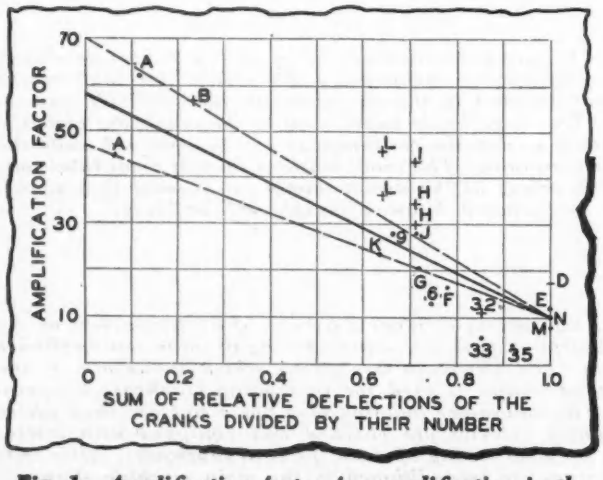


Fig. 1—Amplification factor for amplification in the critical regions of large crankshafts, determined experimentally from torsiogram records.

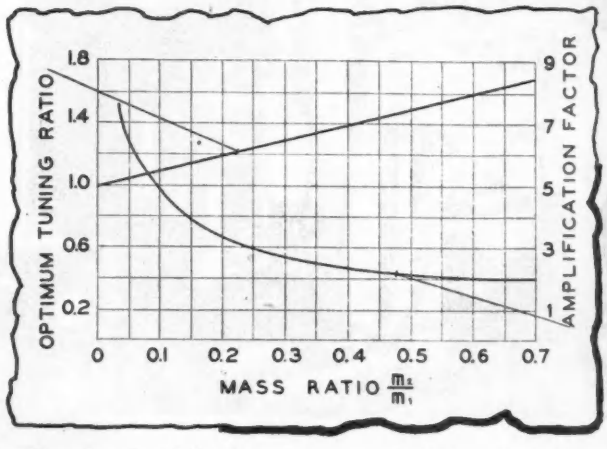


Fig. 2—Amplification factor and optimum tuning ratio for varying ratio of damping mass m_2 to engine mass m_1.

Crank No.	6	5	4	3	2	1
Relative vector intensity..	0.86	0.804	0.726	0.625	0.503	0.376
Phase angle of the exciting force referred to Crank No. 6.....	0°	360 + 240°	3 × 360 × 120°	240°	120°	0°

By J. Geiger

Stresses

In Critical Regions with Damping

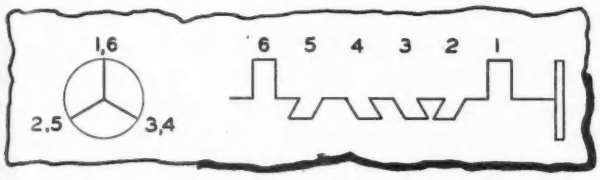


Fig. 3—Crankshaft diagram of six-cylinder, four-stroke engine.

R= resultant of the partial harmonic forces on the separate cranks.

This method will be sufficiently accurate and furnish values suitable for practical conditions (as can be proved by torsiograms) when the damping moment applied to the system is sufficiently small; and also, only if the harmonics of the critical speeds are approximately of the same magnitude. However, the stresses in a higher critical region cannot be determined from stresses recorded in a lower critical region, merely from the ratio of the exciting harmonics; on the contrary, in the higher critical regions the amplitude of oscillation is relatively smaller, and the supplementary strains are less, than in lower critical regions. If the damping is made proportional to the rate of oscillation, as it usually is in theoretical investigations, the amplitude of oscillation in all cases will be proportional to the exciting force. In the actual case, wherever this condition does not apply, the explanation is that instead of one damping moment, there are several, following different laws, which, moreover do not bear a linear relation to the rate of oscillation. The most important of these extraneous damping moments are as follows:

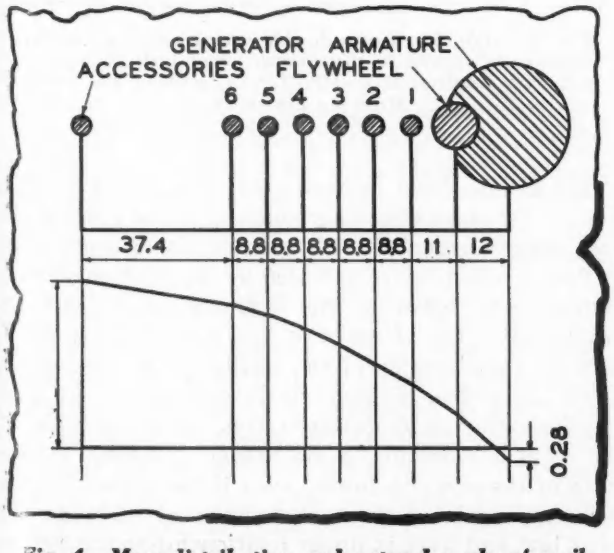


Fig. 4—Mass distribution and natural mode of oscillation of a six-cylinder Diesel-generator set.

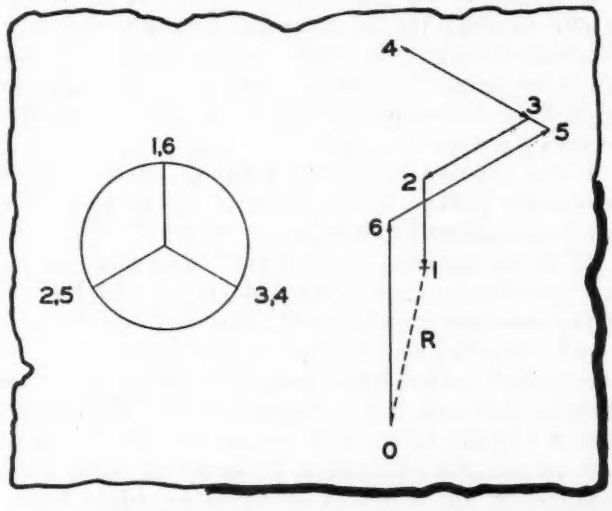


Fig. 5—Vector diagram for the harmonic of the 5.5 order, for the oscillation mode of Fig. 4.

1. Apparent damping due to the reciprocating masses. When the particular crank is in either dead center, the piston does not affect the oscillations of the crankshaft, but when crank and connecting rod are exactly at 90 deg to one another the full influence of the piston is exerted on the vibrations of the crankshaft, and hence the system can never be amplified to vibrations of infinite magnitude while damping and frictional effects are absent. This effect of the reciprocating masses will be greater of course in a four-cylinder engine with cranks at 0 deg or 180 deg, than at 90 deg; the effect of the reciprocating masses on vibration in the case of a six-cylinder engine with cranks at 120 deg is represented for one revolution only by the curve in Fig. 6.

2. The increased bearing friction in shaft journals, on crankpins, piston pins and cylinder walls, caused by torsional oscillations is a further source of damping;

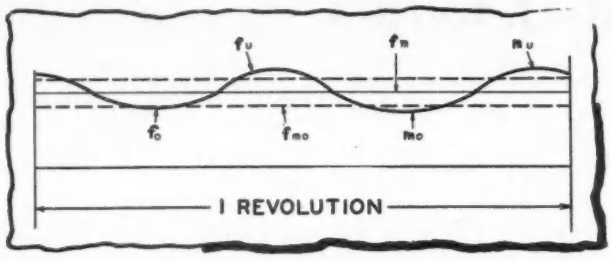


Fig. 6—Variation of the magnitude of reciprocating masses of a six-cylinder, four-stroke engine during 1 revolution.

the development of simple friction on the cylinder walls, disregarding the effect of the supplementary masses, is shown in Fig. 7 for the particular case of an eight-cylinder engine; while Fig. 8 shows the corresponding values for a fourth order critical frequency. This curve differs from the partial values for the individual cylinders owing to the different amplitude of the vibrations. In the same way, Fig. 9 shows the curves of cylinder-wall pressures in the eighth critical harmonic of an eight-cylinder engine.

3. Increased bearing load in the form of end thrust is due to obliquity in the shaft journals caused by torsional deformation; and further damping is produced by impact shocks in the piston-rod guides due to the unavoidable play in the latter, and the pressure reversals caused by vibration.

4. Air friction has little damping effect, but the molecular friction in the material of the shaft may have an important influence.

All these damping factors are independent of the rate of oscillation, and controlled only by a high power of the resultant stress, as will be seen from Curves 2, 3 and 4 in Fig. 10. The last-named damping factor, consequently, is not very apparent in the lower critical regions, although it can become of considerable importance in the higher regions, and this is the reason that in the higher critical regions the stress, fortunately, is not amplified as much as might be expected from the measured stresses in lower critical regions and the ratio of the exciting forces. As shown by Fig. 10, this particular form of damping is greatly affected by the material of the shaft. It is very low in the so-called high-duty steels, and fairly high in ordinary open-hearth grades. These cheaper grades therefore are preferable to the expensive high-grade steels from the viewpoint of damping effect and amplification in the higher critical regions, and they also have an appreciably higher notch resistance.

Since the intensity of the different damping components can vary considerably with cylinder number, crank-setting angle, type and magnitude of the exciting torque, mode of oscillation, and type of material used, it becomes impossible without tedious calculation to determine the intensity of total damping in a crankshaft; particularly since considerable extraneous damping can be set up by the air or water resistance of propellers, eddy-currents in generators, etc., and will again depend greatly on the natural mode of vibration in the particular critical region.

The amplitudes corresponding to the separate critical regions therefore are generally determined by means of torsiograms recorded on similar engines, the method giving rise to appreciable error only in the case of novel designs. In larger units requiring a greater range of safe speeds additional damping devices are frequently introduced, to ensure that the stress increment at critical speeds is kept within reasonable limits.

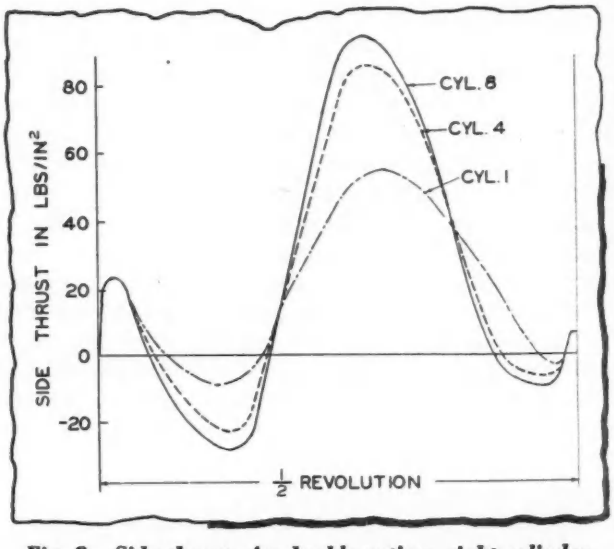


Fig. 8—Side thrust of a double acting, eight cylinder, two-stroke engine in the fourth order critical region, i.e. with additional inertia forces, plotted for three different cylinders.

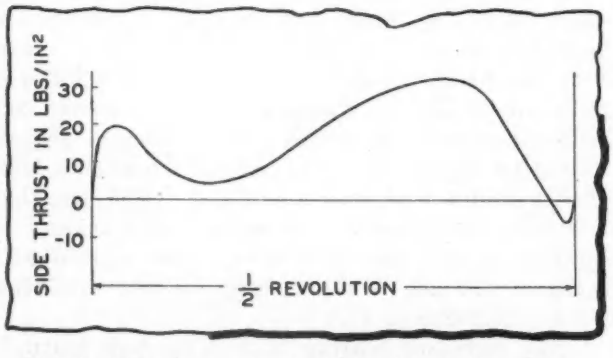


Fig. 7—Side thrust of a double-acting, eight-cylinder, two-stroke engine without additional inertia forces due to torsional vibration.

The damper used in most cases consists of a rotating inertia mass elastically coupled to the crankshaft, and always provided with an additional mechanical or fluid friction device operated by the relative angular displacement between the damping mass and the crankshaft. The effect of such a damper is to maintain the amplification of the oscillating system within 2½-6 times the primary static deflection. At such relatively-low amplification ratios, the amplitude of the critical vibration is no longer governed by the ratio of the exciting forces, even if the natural damping components of the system were all to follow the same law, and were in linear relationship to the oscillation velocity.

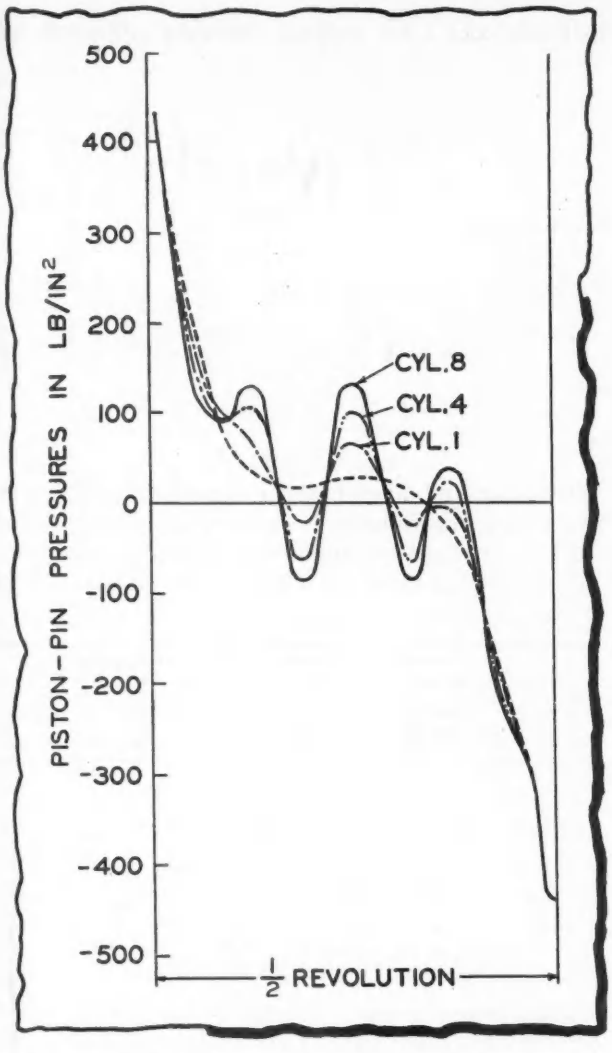


Fig. 9—Piston-pin pressures of the double-acting two-stroke engine in the eighth order critical region with and without additional inertia forces, plotted for three different cylinders.

To make this clear, the position of the point of application of the damping force will now be investigated for the simple case of a system of two masses (Fig. 11):

The mass m_1 is acted upon by a harmonic exciting force P; the other mass m_2, by a damping force $D = k.\ \omega.\ a_2$ proportional to the oscillation velocity. Let k be the damping factor; $\omega\ (= n.\pi/30)$, the angular frequency corresponding to the oscillation rate n; and a_2, the deflection of m_2.

Under inertia conditions, the actual oscillation is composed of two partial modes, phase-displaced by 90 deg: One, in which damping plays no part, and governed solely by the inertia forces and a component of the exciting force P; and one which includes the effect of the damping force D, phase-retarded by 90 deg in relation to the deflection a_2, as well as inertia forces and a component of the exciting force. The two partial exciting forces P are determined by the phase-displacement angle (phase-shift) φ. In the first partial mode, the effective component is $P\ .\cos\ \varphi$, and this is called the C-mode; in the second partial mode the exciting component is $P\ sin\ \varphi$, and it is therefore called the S-mode.

For the resonance case the angle $\varphi = 90$ deg. The C-mode in this case is the natural oscillation, in which the P-component is zero; in the S-mode, in addition to the damping force, the exciting force P is present in full magnitude.

Now let the ratio $m_2 : m_1 = z$, and the relationship between the two oscillation modes (Figs. 12 and 13) and the two corresponding force diagrams (Figs. 14 and 15) be represented by the following expressions:

$$a_1 s : 1 = (P + m_1\ \omega^2\ a_1 s) : H \qquad (1)$$

$$k\omega a_2 c = P + m_1\ \omega^2\ {}_1 s \qquad (2)$$

where:

$a_1 s$ = component of a_1 in the sinusoidal oscillation mode (S-mode)

$a_2 c$ = component of a_2 in the cosine oscilation mode (C-model)

$H = \frac{JG}{r^2}$ = horizontal ray, in which:

J = polar moment of inertia of the shaft of length l.

G = shear modulus.

r = reference radius of the masses m_1 and m_2.

The lengths l in Figs. 12 and 14 and H in Figs. 13 and 15 should be assumed to be equal.

If the shaft is now assumed fixed at m_2, and the force P is applied statically, there will be an angular displacement between m_1 and m_2 (Fig. 12—C-mode of

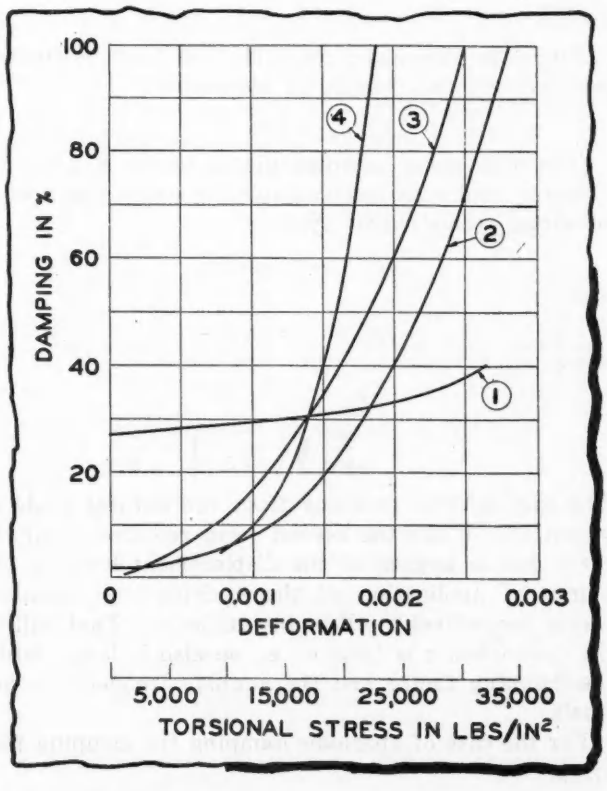


Fig. 10—Relationship between the relative damping ψ and the deformation γ and torsional stress τ
1. Grey cast-iron
2. Steel 48 } ***tests by Kimbara***
3. Co.-Cu. steel
4. Steel B (0.30% C, 0.63% Mn, 0.31% Si, 0.013% S, 0.019% P, 0.12% Ni.)

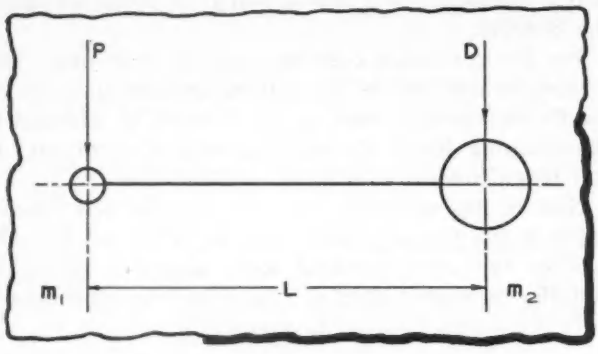


Fig. 11 — Torsionally-oscillating, damped system of two masses.

oscillation for the system of masses according to Fig. 11):

$$a_{stat} = \frac{Pl}{\frac{JG}{\gamma^2}} = \frac{Pl}{H} \tag{3}$$

Then, from eq. (1):

$$a_{1S} = \frac{Pl}{H\left(1 - \frac{\omega_2}{\omega_1^2}\right)} = \frac{a_{stat}}{1 - \frac{\omega^2}{\omega_1^2}} \tag{4}$$

in which ω_1 represents the natural cyclic frequency of the system m_1, l, assumed fixed at m_2. Then, from equation (2)

$$a_{2C} = \frac{Pl}{k\omega} \times \frac{1}{1 - \frac{\omega^2}{\omega_1^2}} \tag{5}$$

Since the resonance condition has been postulated, we have for the C-mode of oscillation:

$$a_{1C} = z\, a_{2C} \tag{6}$$

The consequent angular displacement A *adyn* between m_1 and m_2, which controls the stress, can now be obtained geometrically from

$$a_{1C} - a_{2C} \text{ (C-mode)}$$

and

$$a_{1C} \qquad \text{(S-mode)}$$

since

$$\Delta a_{dyn} = \frac{P}{1 - \frac{\omega^2}{w_1^2}} \sqrt{\left(\frac{z+1}{k\omega}\right)^2 + \frac{2}{H^2}} \tag{7}$$

The first addend proceeds from the natural mode of vibration. While the second term remains small the error due to neglect of the displacement between the points of application of the exciting and damping forces respectively, will be insignificant. That will be the case when z is large, i. e., m_2 also is large, while the damping factor and the angular frequency ω are small.

For the case of aperiodic damping the damping factor is

$$k = 2\sqrt{cm}$$

and generally

$$k = k_o\sqrt{cm} \tag{8}$$

where k_o is a non-dimensional constant, e. g. 2 for aperiodic, and 1 for periodic damping. Consequently

$$k\omega = k_o \times \frac{H}{l} \tag{9}$$

$$a_{dyn} = \frac{a_{stat}}{1 - \frac{\omega^2}{\omega_1^2}} \times \sqrt{\left(\frac{z}{k_o}\right)^2 \times \left(\frac{\omega_1}{\omega}\right)^2 + 1}, \tag{10}$$

For example:—

$$z = 1 : k_o = 1$$

The natural frequency of the system is then:

$$\omega = \sqrt{\frac{H}{l}} \times \sqrt{\frac{m_1 + m_2}{m_1}} \text{ and}$$

$$\frac{\omega_1^2}{\omega^2} = \frac{1}{2}, \text{ hence}$$

$$a_{dyn} = -1.73\, a_{stat}$$

Stressing and amplification therefore are greater than where the S-mode is neglected, in the ratio of $\sqrt{3/2}$ to 1. That is, they are 22.5 per cent greater.

The following table gives the values in this case for variable damping:

Damping	Amplification	Per Cent Error
2 × aperiodic.....	1.12 times	124%
aperiodic.....	1.228 times	73%
½ × aperiodic.....	1.73 times	22.5%
¼ × aperiodic.....	2.24 times	12%
⅛ aperiodic.....	5.75 times	1.5%

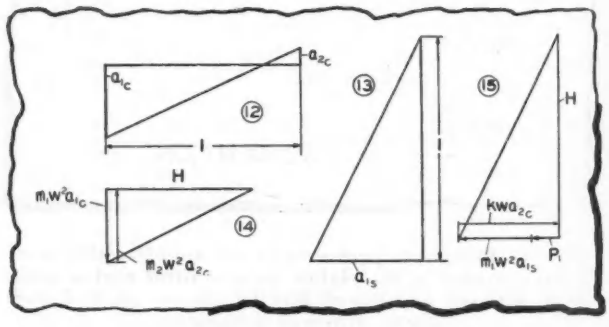


Fig. 12—C-mode oscillation of a binary mass system (left-hand, top).
Fig. 13—S-mode oscillation of a binary mass system (middle).
Fig. 14—Force diagram of the C-mode oscillation (left-hand, bottom).
Fig. 15—Force diagram of the S-mode oscillation (right-hand).

The error thus is insignificant for low damping, i. e., for high amplification: with low amplification, however —which is desirable because it prevents high torsional stressing, it can become considerable.

If on the other hand, the damping force D had been applied at the same point as the exciting force P, the error would have been zero at all points.

Thus, in determining the incremental stresses in the critical regions, the point of application of the damping force is vitally important, as well as the point of application of the exciting force. Furthermore, with high effective damping, that is, when the amplification is less than three times the static deflection, a corresponding correction must be made in the incremental stresses determined from torsiograms taken at the free end of the shaft. When the amplification factor exceeds five, this correction may be omitted.

Metallurgy of

Foreign Materiel

By Col. J. H. Frye*

Office of Chief of Ordnance

A FOREIGN Materiel Branch was established at the Ordnance Research and Development Center, Aberdeen Proving Ground, under the supervision of the Technical Intelligence Branch of the Ordnance Department, to receive, catalog, proof test and arrange captured enemy materiel for engineering study and analysis. Over 1400 different types of enemy equipment, weapons, ammunition and automotive vehicles have been examined by Governmental research organizations, including technical teams in combat areas, in collaboration with commercial and private experts. Some of the findings are reported in the following summarization.

Japanese Materiel

Captured materiel confirms the statement that for years Japan has also been stockpiling the finished implements of war. The Ordnance Department has recovered, proof-tested and made engineering examinations of every type of Japanese tank and automotive vehicle that has appeared in battle. Some of the Japanese light trucks and command cars have been of American manufacture, while others have been copies of various foreign designs. Modifications to facilitate Japanese manufacture and minor improvements often have been made, but in general their vehicles conform rather closely to practices of several years ago. Apparently they have inhibitions against identifying their equipment with the date of manufacture, but it appears that the vehicles encountered up to this time have largely been of earlier manufacture and may not represent the latest designs and practices. [Editor's Note: Aircraft is an exception to the Japanese practice of not giving date of manufacture.]

The tank represents the result of Japanese light tank development for their preparation for war. Certain features can be traced to foreign prototypes, but essentially it is an independent Japanese development. This vehicle weighs approximately 8.4 tons and has a maximum road speed of 30 mph. It is powered with a six-cylinder in-line, air-cooled Diesel engine rated at 110 hp at 1400 rpm. The theoretical radius of action is 100 miles with full use of fuel capacity. Production of this tank was started about 1935, and it is believed that a stockpile of finished vehicles was available at the outbreak of war. This will account for the extremely rich alloys used in its components. It is apparent from their future supply situation with regard to ferro-alloys, particularly nickel, that the use of such rich alloys cannot continue in production during the war years.

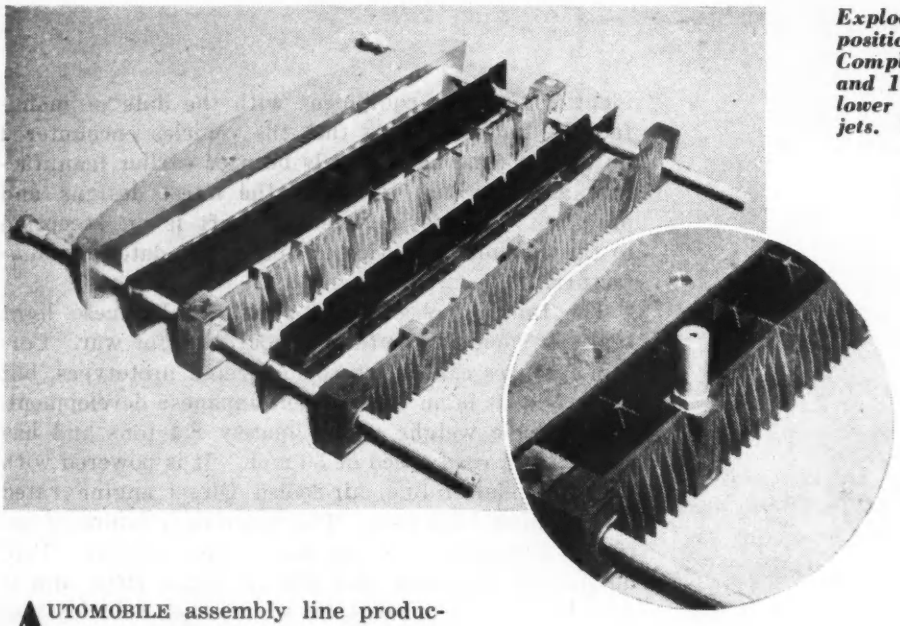
It seems wasteful to use 2 per cent nickel in track pins, especially when compared with our practice of using low-alloy hardening grades. The advantage of using carburized pins can be questioned. The use of austenitic manganese track links are beyond the possibilities of a major war economy. The final drive pinion and crankshaft are both exceptionally high in nickel and chronium, and the use of this quantity of alloy compares unfavorably with U. S. practice and that of the Germans. In the German heavy tank, the engine crankshaft is essentially 1345, while its pinion gear is made from essentially 4120. The exhaust and

(*Turn to page* 90, *please*)

German Heavy Duty Engine and Transmission-Gear Compositions and Treatments

GEAR	ALLOYING ELEMENTS C	Mn	Si	CR	Mo	HARDNESS	HEAT TREATMENT	PROCESSING METHOD
Dog Clutch	.24	1.32	.31	1.35	.02	Case Rc 64 Core Rc 40/47	Carburized .040 in.	Forging
Gear	.20	1.31	.31	1.30	.02	Case Rc 62 Core Rc 35	Carburized	
Timing Gear	.25	.40	.25	1.44	.06	Case Rc 62 Core Rc 20	Nitrided	Bar Stock
Camshaft Gear	.45	.45	.28	.06	.01	Rc 25	Normalized	Forged Casting
Pinion and Shaft	.42	1.23	.01	.07	.01	Rc 94	Normalized	Bar Stock
Starter Gear	.28	1.36	.37	.15	.01	Rc 17	Quenched & Tempered	Forging
Clutch Gear	.44	1.26	.68	1.25	.01	Rc 33	Normalized	Forging
Sliding Gear	.25	1.31	.24	1.23	.01	Case Rc 63 Core Rc 39	Carburized .020 in.	Forging
Cluster, Gear, Large	.25	1.19	.30	1.25	.01	Case Rc 60 Core Rc 39	Carburized .030 in.	Forging
Cluster, Gear, Small	.20	1.25	.32	1.35	.01	Case Rc 61 Core Rc 44	Carburized .060/.070 in.	Forging

* This article is an abstract of paper presented at the War Engineering-Annual Meeting of the Society of Automotive Engineers, Jan. 8-12, 1945, at Detroit.



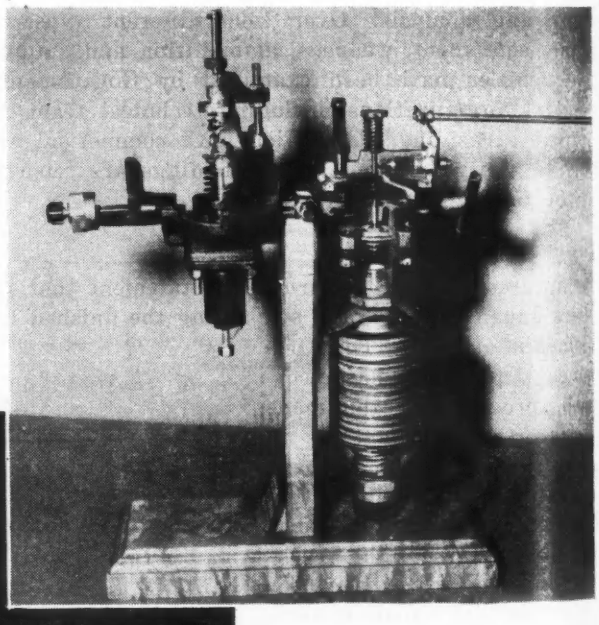
Exploded view of grid assembly, showing position of flapper plates and grid bars. Complete grid consists of 15 grid bars and 16 flapper plates. Tapped holes in lower grid bar are for insertion of fuel jets. The inset shows one of the fuel jets in place.

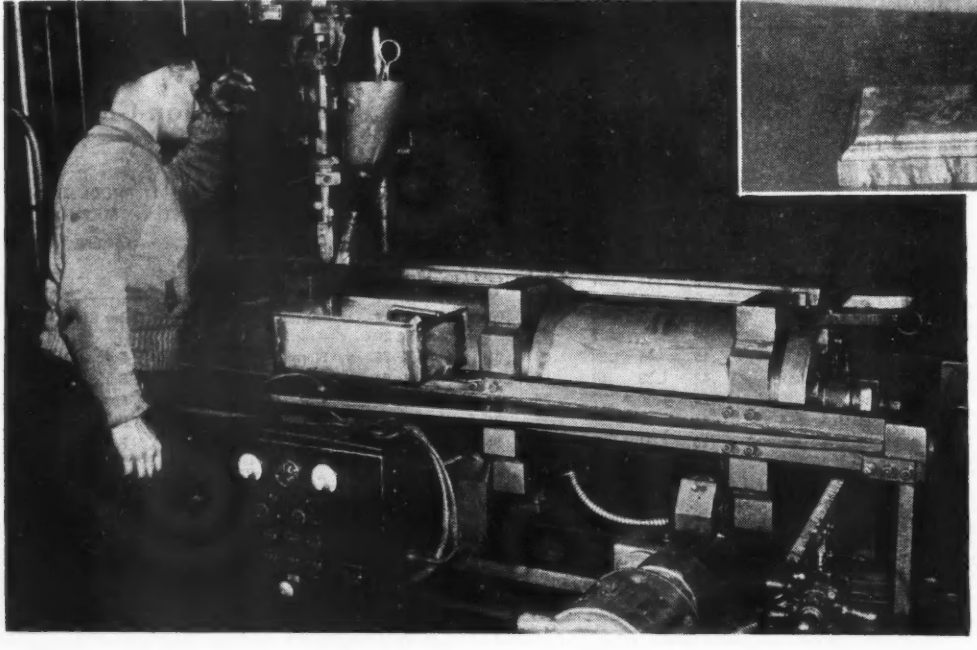
(Circle) Section of grid assembly showing finned grid bars, flapper plates, and fuel jets. Completed grid has nine fuel jets.

By Leonard Westrate

AUTOMOBILE assembly line production methods now are being applied to manufacture and assembly of robot bombs at Ford Motor Co. in Detroit and at Willys-Overland Motors, Inc., Toledo, Ohio. Ford is making the intermittent jet engine which powers the weapon, and Willys is fabricating the fuselage, wing sections, rudder, and tail assembly, and installing the operating equipment.

The engine, which develops approximately 3 thrust hp per pound and weighs about 300 pounds, will drive the weapon at a speed of from 350 to 400 mph. The effective range of the bomb is more than 150 miles, but is dependent mostly on the fuel load and the size of the warhead. Range of the weapon is controlled by an ingenious timing device, consisting of a small spinner mounted at the nose. This is attached to the shaft of a counting device which translates the number of revolutions into miles of travel. When the predetermined number of revolutions is reached, the device trips a needle valve to shut off the fuel flow to





(Above) Cutaway fuel metering unit.

(Left) Automatic arc welder runs seam on section of robot bomb engine at Ford Motor Co. Sections of engine are rolled circular and tack welded at end of joint before being placed in special welding jig.

Assembly Line Methods Applied to

American Robot Bomb

the engine, frees the rudder, locks the elevators, and drops two hinged spoilers which send the bomb into either a glide or spiral dive into the target. The weapon can be set to fly at altitudes as low as 100 feet, which makes it extremely difficult to knock down by anti-aircraft fire. The robomb has an overall length of 27 feet, a wingspread of 17 feet, and weighs approximately 5100 lb, of which more than 2000 lb represents warhead.

Rate of production of the robomb is restricted information, but it is reported that the Detroit area soon will become the robot bomb center of the country. In setting up a pilot line for the engine job, Ford has tooled on a permanent basis, so that production facilities can be greatly increased quickly if called for. Plant space also is available that could be cleared for the job in less than two weeks. If the program is greatly expanded, it is expected that other automotive companies in the Detroit area will be called on to build either components or complete assemblies.

Design of the American engine is amazingly simple. (A description of the German design was published in the Nov. 15 issue of AUTOMOTIVE AND AVIATION INDUSTRIES.) It consists of three principal tubular sections welded together, measuring 131 in. overall in length and tapering down from a diameter of 22½ in. at the combustion chamber to 15⅜ in. at the discharge duct. A transition unit is welded to the front of the combustion chamber and is tapped for studs which hold in place a gridwork containing nine fuel jets and a series of spring flaps.

Operation of the engine also is simple. Air pressure from the forward velocity of the weapon forces the spring flaps open and builds up pressure in the combustion chamber. Venturis between the grid and combustion chamber help to improve the air-fuel mixture and ram. When fuel is introduced, heat generated by the pressure and from previous explosions touches off the charge. The force of the explosion closes the flaps, preventing escape of the gas through the grid,

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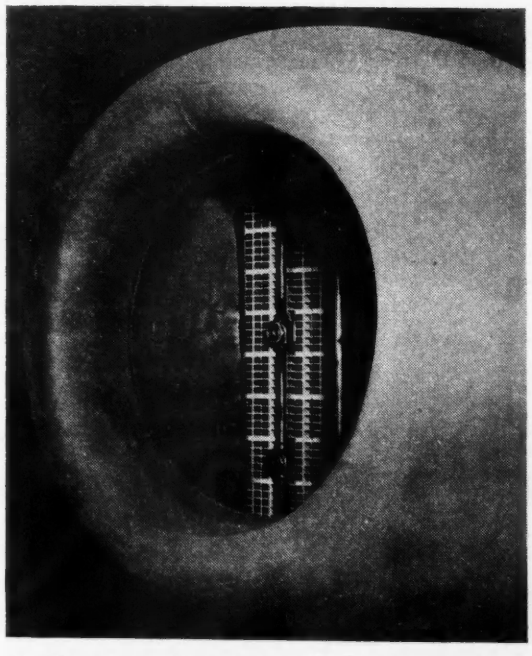
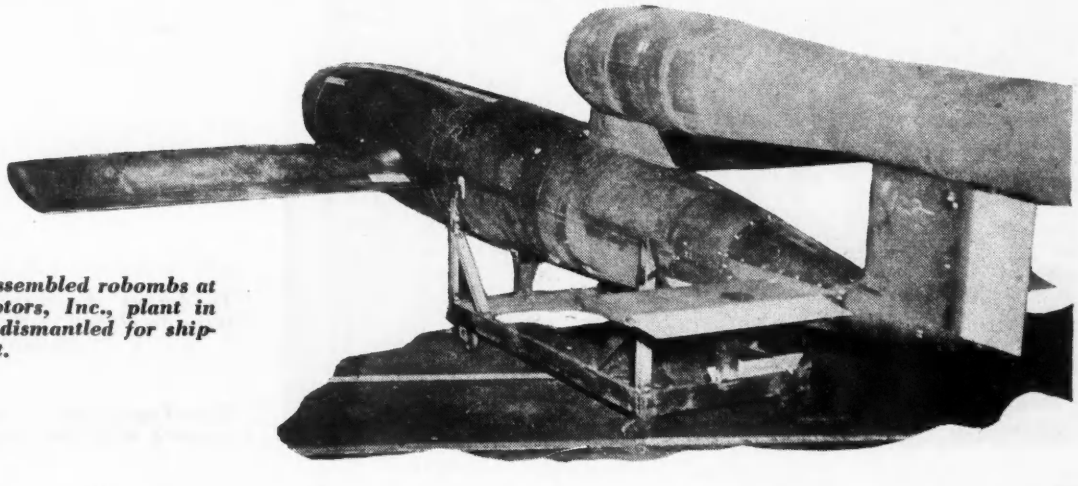


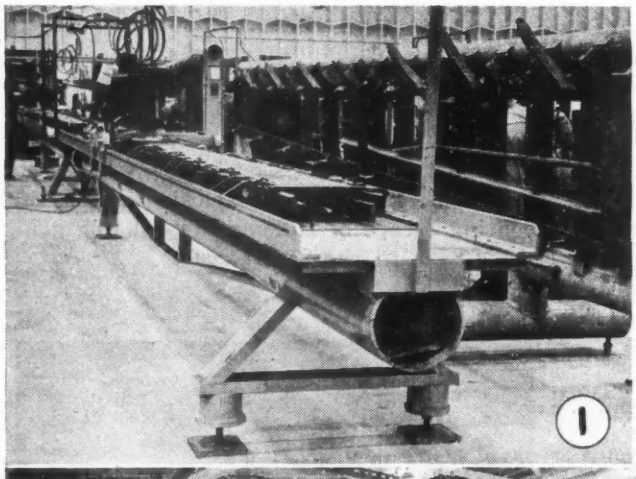
Cowling and grid at front of robot bomb engine.

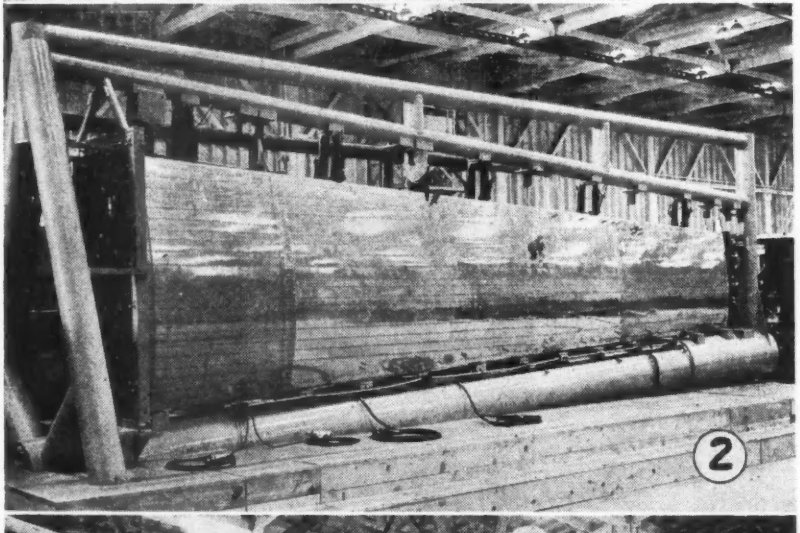


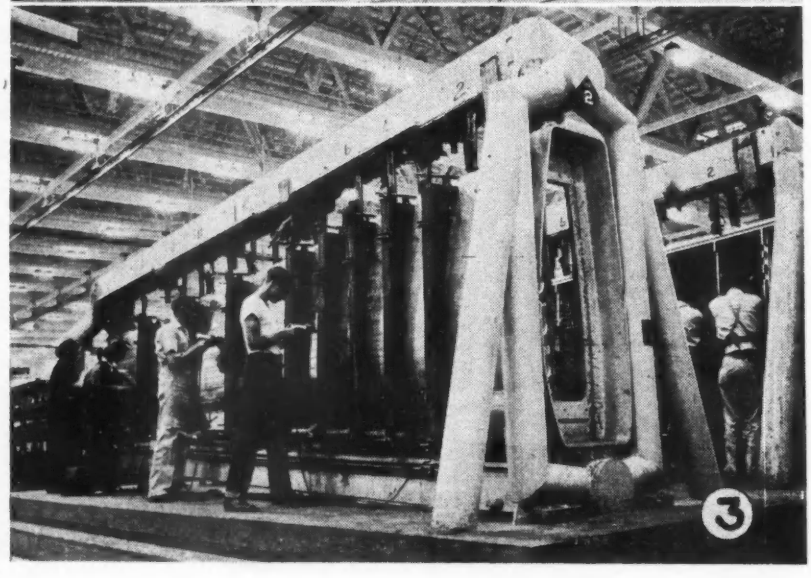
One of the completely assembled robombs at the Willys-Overland Motors, Inc., plant in Toledo just before it is dismantled for shipment.

Three-Point Support

By A. C. Edmiston
Superintendent,
Manifold Production Engineering,
Ryan Aeronautical Co.







ACCURACY presents the first problem with which most tool designers are confronted in the design of assembly fixtures.* The second problem, and one that is quite often overlooked, is the designing of a fixture that will maintain this accuracy throughout its entire period of usefulness.

Here at the Ryan Aeronautical Co. we have endeavored to achieve maximum accuracy by carrying the three-point fixture to a higher state of development than have many other manufacturers. The military services on a number of occasions have arranged for tooling experts from other plants to visit our factory for detailed studies of the methods we use. Consequently, because of this recognition of Ryan tooling technique, it may be of assistance to others to discuss in some detail just what we have done along this line.

Obviously, the most essential factor in producing an accurate fixture is the base on which it is constructed, for, like a building, the fixture is no better than its foundation. It has been quite common practice in the construction of large assembly fixtures to employ the use of reinforced concrete foundations, and in many cases, no foundations at all, other than a regular concrete floor. This is a satisfactory arrangement providing the floor or special concrete base is strong enough. However, there are definite problems connected with this arrangement in some locations, as is the case of factories built on filled ground near the ocean where the floor moves with the tide. In order to eliminate this problem it has been necessary to construct assembly fixtures on bases entirely independent of the floor and not

*The terminology of Tooling Department varies with their respective locations. What is considered a "jig" in one place might be termed a "fixture" in another, or a "buck" in still another. However, for the purpose of clarification, the term "fixture" as used here pertains to any rigid structure either of wood or metal which holds parts in their respective locations while being assembled.

1—Among the three-legged designs of fixtures developed at Ryan is this drill table for assembling spars.

2-3—Two fixture designs of the three-point support type for assembling wing sections.

for Assembly Fixtures

affected by any changes created by tides or other possible movements of the floor. The required results were achieved by the application of an old idea in a different form.

The man who designed the three-legged milking stool was probably faced with a similar problem. He was interested in building a stool that would be rigid and yet would not require a solid level foundation under it. Consequently, he used three supporting points, thus enabling him to have a substantial place to sit instead of rocking back and forth because of uneven ground. At Ryan we have found this three-point support system to be the solution to the problem of uneven or changing floors.

In order to carry out this idea it was necessary to provide a base for the assembly fixture that was designed in such a way as to be sufficiently strong and rigid within itself to be supported on these points with a minimum amount of deflection. The most logical material that was available and of sufficient strength to accomplish the desired results was tubular sections such as oil well casing. Since the initial use of this type of fixture construction, various types and shapes of material has been used with success. However, the use of round tubing has proven satisfactory in the majority of cases. It is not the intent of this article to discuss the merits of round or square tubing, as its use depends upon the individual problem.

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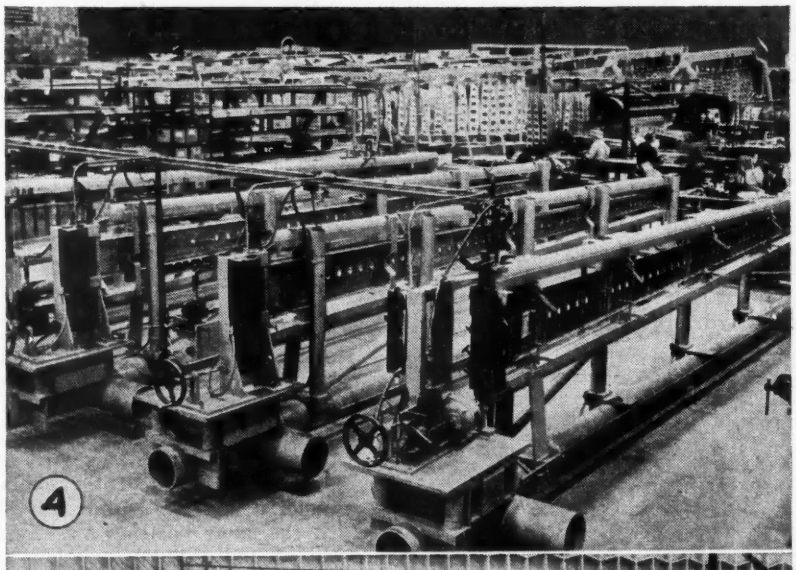
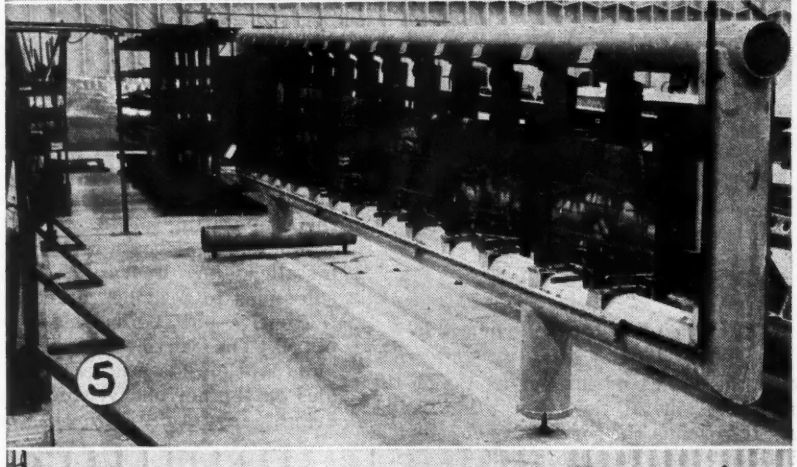
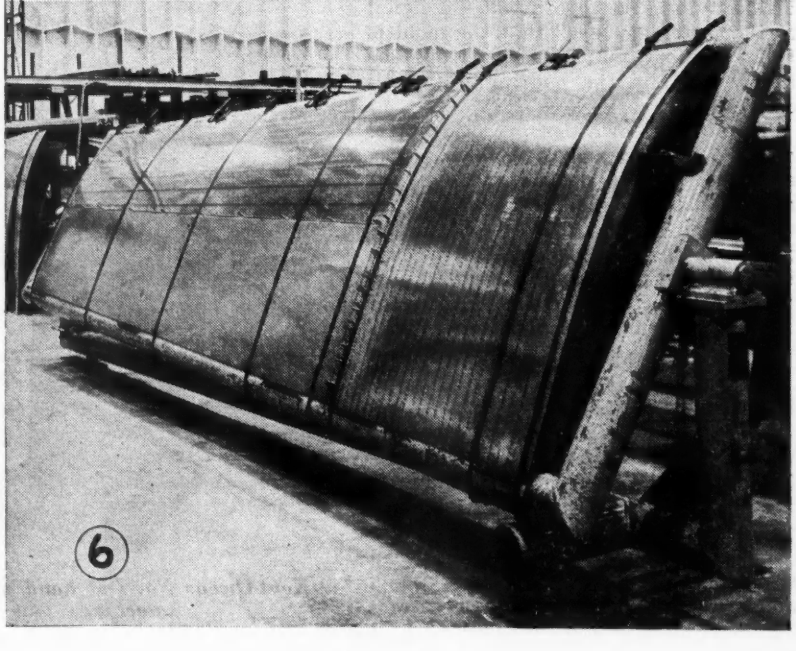






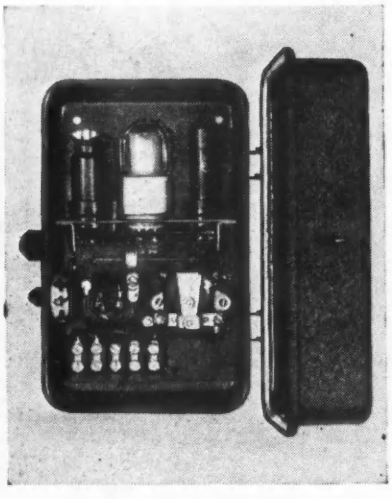
4—Spars for an outer wing panel assembly are held rigidly in these three-point support fixtures while being milled with special spar milling machines.

5—Assembling, drilling and riveting of skin panels for an outer wing section can be accomplished at this fixture with complete freedom of action. It also can be moved quickly to another part of the factory.

6—Trunnion type fixture supported at three points.

New Production Equipment

PHOTOSWITCH photoelectric control Type A20C, made by Photoswitch, Incorporated, Cambridge, Mass., provides automatic control of pouring operations in foundries where it replaces hand-pouring methods. With the help of Photoswitch "electric eyes," one operator, working from a remote station, controls the pouring of several ladles simultaneously. As each of the group of empty molds moves into position before a ladle, a Photoswitch photoelectric control mounted directly above watches through a viewing tube. When the molds are in place, the operator, through push button control of the hydraulic actuating mechanism,



Photoswitch control Type A20C

tips the ladles of molten iron and the white-hot metal flows into the molds. As it reaches the riser of each mold, a brilliant light is thrown off—a signal to the watching "eye" that the mold is full. Photoswitch instantly drops the ladle back and the pouring automatically stops.

Type A20C provides precise control of this and other widely differing processes because of its ability to detect minute changes in light intensity. An adjustment on the control housing may be set so that the control will remain inoperative at one level of illumination, but will be actuated when the amount of light reaching the phototube varies slightly.

KENT-OWENS MACHINE COMPANY, Toledo, Ohio, is placing on the market a new special arrangement for its No. 1-M hand milling machine for milling staking notches in rockets, shells, adapters and similar parts. The machine is equipped with a special head having three spindles, each carrying a notching cutter. These three cutters are equally spaced about the shell diameter.

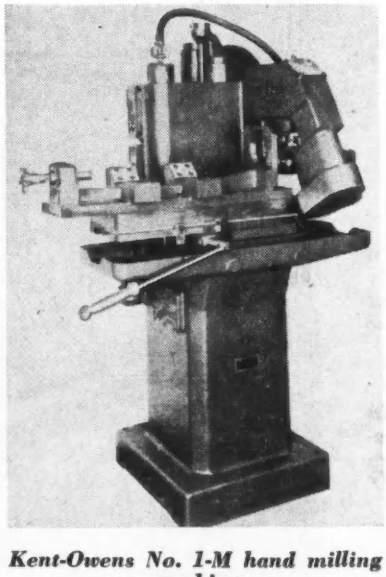
The shell is located in the bore at the cutting end of the fixture as shown. The bayonet type clamp at the rear of the fixture permits rapid clamping and unclamping of the part. When milling notches in adapters an air operated fixture is used for holding the part. With this arrangement all three notches are milled simultaneously.

AN AUTOMATIC-CYCLE, special-purpose machine has been designed and built by Snyder Tool & Engineering Company, Detroit, Mich., for tapping 61 holes of various diameters and in various positions in an aircraft housing.

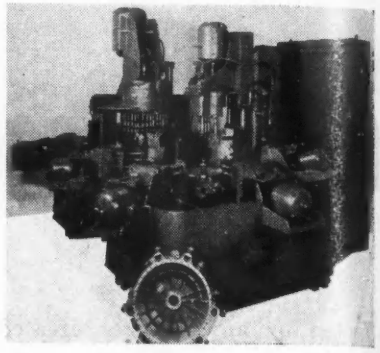
With the part located and clamped in central position on the fixture slide, the starting button sends the slide and part to the left of the operator and under a multiple spindle tapping head. In the same position are several horizontal and angular units with tapping spindles. All the tapping spindles have individual lead screws.

When the left half of the machine has completed its cycle the part is moved automatically past the central loading station to the right where another group of vertical, horizontal and angular tapping spindles go through their operating cycle.

A number of these tapping units are installed on hydraulically operated sub-slides to provide rapid advance of the entire unit before lead screw tapping. The vertical head in the left hand station has a large group of spindles on the periphery which has no hydraulic advance. However, the cluster



Kent-Owens No. 1-M hand milling machine



Snyder special tapping machine

of spindles in the center of the head is automatically advanced into tapping position several inches lower than the outer spindles.

LANDIS TOOL CO., Waynesboro, Pa., has developed a centerless thread grinder which grinds threads on hardened socket set screw blanks in all sizes from No. 4-48 pitch to ⅝ in.-11 pitch with controllable precision and at a high rate of production. Larger diameters, up to 5 in. maximum, and

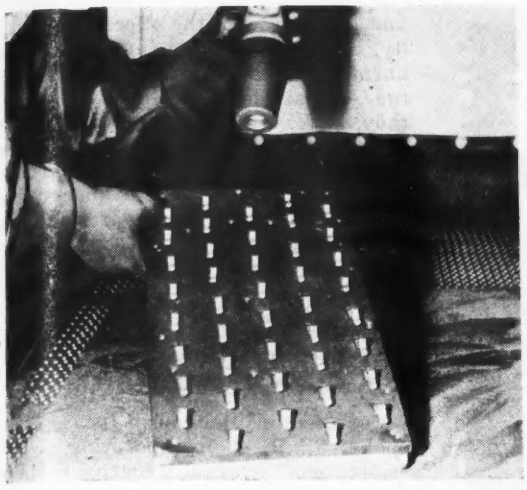
Landis Tool centerless thread grinder

threads coarser than 11 pitch may be ground, but require more than one pass through the machine. The helix angle should not exceed 5 deg.

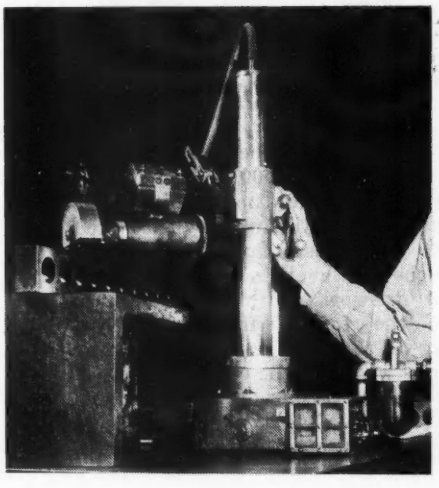
The centerless thread grinder is built on a substantial bed which provides space for the coolant tank, hydraulic pressure pump and oil pump, coolant pump, electrical control panel and the motor-generator unit for the regulating wheel drive. The regulating wheel base has been designed to provide the necessary movements essential to thread grinding. The regulating wheel spindle is powered by a variable-voltage drive giving infinite speeds within the given ranges. Two speed ranges are available for grinding, while a fixed speed of 300 r.p.m. is used for dressing the regulating wheel. The regulating wheel base is moved hydraulically past a stationary diamond when dressing the regulating wheel. The self-contained grinding wheel base supports the grinding wheel spindle and the motor for driving the spindle.

(*Turn to page 78, please*)

Short Cuts

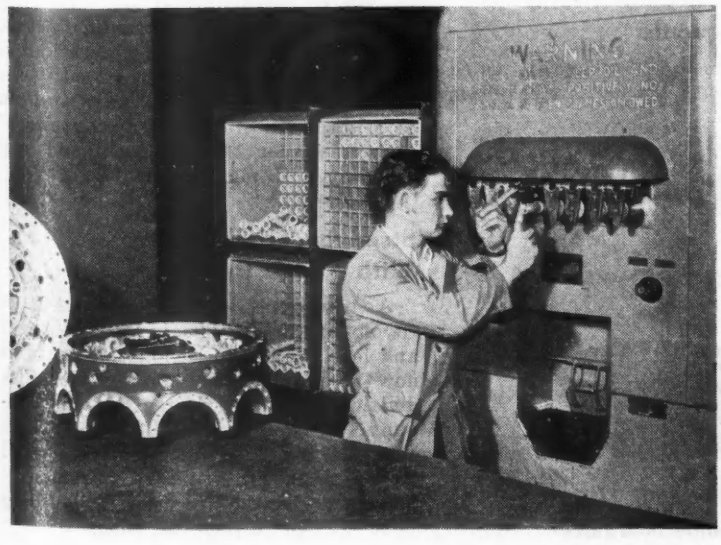


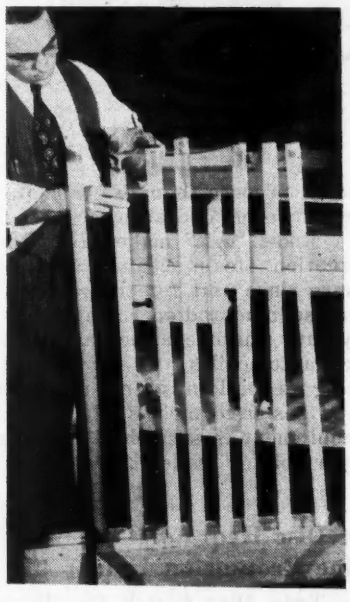
Full-time operation of blast cabinets has been made possible by installing a sheet of Compar, a rubber-like plastic, to protect their perforated bottoms. With boiler plate as the protective covering it was found that the force of the steel grit driven 90 lb pressure wore down the plate in a short time, necessitating its replacement every three or four hours. Compar sheet is reported to have a resistance to abrasion of 250 times that of boiler plate. The wooden tray also is covered with the Compar to permit continuous use.



The necessity of dismantling large jigs, fixtures, or machinery for the purpose of grinding worn surfaces has been largely eliminated at the Vultee plant of Consolidated Vultee Aircraft Corp. with the development of this portable precision grinder that can hold tolerances within .004 in. The grinder consists of a base block containing air and hydraulic lines, a hydraulic cylinder, a piston, a rack and gear, and an air valve and rack control mechanism. Out of this rises a vertical shaft on a sleeve that allows a full 360 deg traverse. This horizontal track carries an air motor which is provided with precision vertical adjustments that are regulated by an attached knob, one complete turn of which raises or lowers the grinder surface .004 in. Horizontal oscillation of the arm is controlled by a screw shaft located in the base, which also houses the valve that governs the air motor.

At the Ford aircraft engine plant the use of a combination refrigerating machine and dispenser has cut in half the time for a single assembly operation which depends on shrinking tappet guide inserts, 36 for each Pratt & Whitney 2000 hp-engine, by the liquid oxygen method to minus 300 F. There are eight openings to accommodate various size guides. To obtain a shrunk part, the operator inserts one from stock and presses a solenoid button, a chilled part then dropping into the rubber receptacle at hand level. The inserts are chilled during their slow passage through tubes suspended in the tank of liquid oxygen. The machine was built by the Linde Air Products Co.



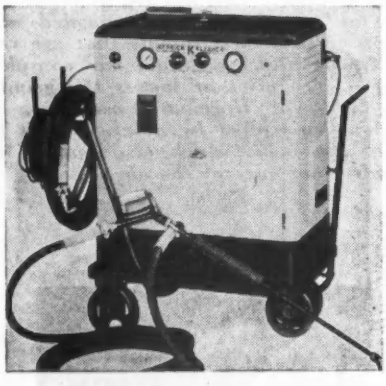


Burned-out fluorescent light tubes are salvaged at The Glenn L. Martin Co. to mold plastic rods for use as tool handles, stiffeners, etc. One end of the burned-out tube is cut off and the tube itself is filled with a liquid Catabond or Catavar thermosetting resin, then placed in an oven for curing. The cured plastic, still in the tube, is removed from the oven and the glass broken and chipped off, leaving a perfect rod which requires a minimum of polishing and can be cut to various lengths depending on the use to which it will be put.

New Products

Two New Kerrick Kleaners Announced

New Models "A" and "AR" Kerrick Kleaners have been announced by Clayton Manufacturing Company, Alhambra, Cal. A feature of these cleaners is an inverted burner, mounted over the coil and operating on the downdraft principle. This unconventional design places the burner and all control mechanisms at working height for quick and easy inspection and service. Soot and carbon deposits are removed by flushing with the vaporized solution from the cleaning gun, without shutting down or dismantling the Kerrick Kleaner. Thermal efficiency has been



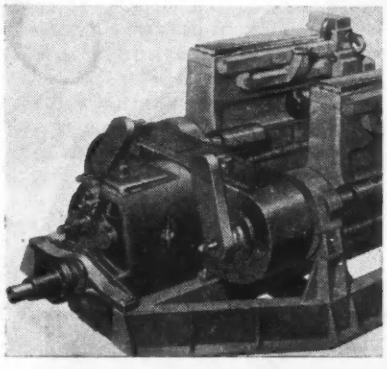
Kerrick Kleaner

increased to more than 75 per cent, resulting in lower operating costs.

The Model "AR" makes available a combination steam cleaner and high-pressure rinse unit for the removal of oil, grease, mud and encrustations from heavy-duty equipment such as tractors, trucks, automobiles and for industrial cleaning of buildings and machinery. Oil and gas fired models are available and equipment is furnished as stationary, portable or trailer types.

Twin Disc Hydraulic Marine Propulsion Unit

The Twin Disc Clutch Co., Racine, Wis., has designed and is building a new hydraulic unit which permits two marine engines to turn a single screw. This assembly, known as the Model ME-300 multiple engine hydraulic drive, is readily adaptable to installations of all makes of Diesel and gasoline propulsion units utilizing a pair of engines developing 150 hp each in the speed range of 1200 to 1800 rpm. For twin screw propulsion, two pairs of engines of this capacity, each pair driving through an ME-300 unit, can be



Twin Disc Model ME-300 multiple engine hydraulic drive

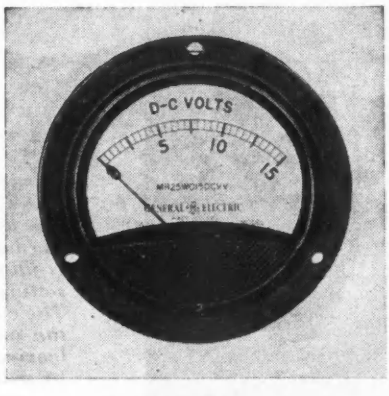
used. This arrangement provides a maximum output of 600 hp.

The Twin Disc multiple engine drive consists of a hydraulically actuated MG-300 Twin Disc marine gear which is attached to a chain case assembled on the flywheel end of the engines. Within the fabricated, welded steel housing of the case are two hydraulic couplings which tie the engines together and transmit the power to the marine gear by means of a chain drive.

The Twin Disc multiple engine drive is so designed that it offers the choice of two installation plans, either of which is also applicable in cases where four engines are employed, each pair driving a single shaft to provide twin screw propulsion. One arrangement calls for the mounting of the chain case and marine gear aft of the engines or, if preferred, the chain case may be mounted forward, with the drives from the engines attached to the opposite side of the chain case and the propeller shaft extending aft between the engines.

Hermetically Sealed Panel Instruments

A line of 2½-in. hermetically sealed panel instruments, housed in steel cases



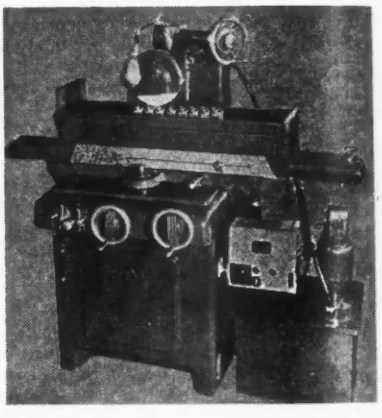
G-E panel instrument

and immune from the effects of humidity, moisture, chemical fumes, and other harmful agents, has been introduced by the General Electric Company, Schenectady, N. Y. These new instruments, for direct-current voltmeters and ammeters and for a-c radio-frequency ammeters, can be furnished in all standard ratings mentioned in, and conform to the performance requirements of American War Standard ASA Specification C-39.2-1944.

Five-In-One Hydraulic Valve on New Grinder

Continental Machines, Inc., Minneapolis, Minn., is incorporating a new "five-in-one" hydraulic control valve in the DoAll G-10 surface grinder to provide increased speed, efficiency, simplicity of operation, and greater accuracies. The new machine tool is said to grind surfaces with precision to 6 micro inches.

The G-10 DoAll has a variable table travel of O to 50 fpm with a cushioned reversing action operated by the pilot valve. To accomplish this, two valves



DoAll G-10 surface grinder

are necessary—a table control valve and a table reversing valve.

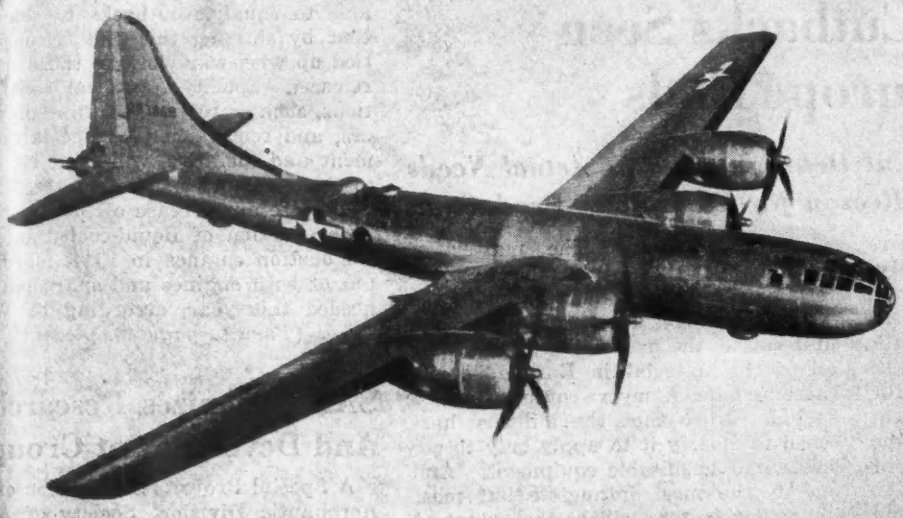
The crossfeed action (indexing at the end of the table travel) is actuated by a hydraulic cylinder and can be controlled in infinite settings from .004 in. to .200 in., depending on the work being done. The crossfeed or traverse action, in addition to hydraulic operation, is also actuated by a screw located in the center of the cross travel ways and can be held to split "tenths of a thousandth" for close tolerances on form and tool grinding with manual operation.

Stronger Truck Tires With Fewer Plies

A new type of truck tire built of rayon cord, which is said to be stronger and less subject to serious blowouts, is now in mass production by the Fisk division of United States Rubber Company. Greater durability has been achieved through the scientific use of stronger but fewer plies in its construction, and with the necessity of handling

(*Turn to page 62, please*)

SPEED NUTS OVER TOKYO



Boeing uses thousands of SPEED NUTS on every B-29 Superfortress to make them lighter, faster and deadlier.

Photos courtesy of Boeing Aircraft Company

SPEED NUTS HELP THESE BOEING WORKERS BOOST B-29 PRODUCTION

TINNERMAN PRODUCTS, INC.
2059 Fulton Road, Cleveland 13, Ohio

In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario *In England:* Simmonds Aerocessories, Ltd., London

Speed Nuts PATENTED *Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS

No Immediate Cutbacks Seen When War in Europe Ends

Lack of Clear Cut Determination of Actual Needs Appears to Be Reason for Continuing Production

When the war in Europe ends, there probably will be no cutback in war production of any consequence for at least a couple of months, according to the best available evidence. The need for continuing production for the Japanese phase will be one factor responsible for continued output, but the principal reason at the moment appears to be the lack of any clear-cut determination of what the needs will be.

There is evidence, too, that the old battle lines between the military and civilian officials are being re-established in Washington and that a fight is shaping up on the issue of whether war output is to be continued full blast after Germany falls or whether a limited reconversion to civilian production of essential goods is to be allowed concurrently. All the implications from Washington in recent weeks have pointed to the continued heavy emphasis on war production. On the other hand, it is reported that WPB regional directors have been called in for conferences on cushioning the shock of the transition period from all-out war production to partial reconversion. Here are some of the facts that will have to be considered in determining just how much reconversion can be allowed.

Civilian goods are wearing out and disappearing fast. The rate of replacement of those goods that have been made to some extent during the war will be further cut down by recent directives cutting the use of steel approximately 25 per cent and of copper 10 per cent during the second quarter of 1945. The full production of munitions, now at the highest peak in history, over an extended period would so seriously deplete the supply of essential civilian goods and weaken the domestic economy that the flow of munitions to the front would be reduced.

It also must be considered whether the Japanese war would require as much war output as now is being used for two wars. Competent observers say that the premise of "The more we produce, the sooner the war will be over" is not necessarily valid, because there is a limit to the amount of materiel that can be used, consistent with shipping facilities and geographical disposition of troops. The matter of transfer of surplus and usable war materials from the Western Front to the Asiatic theater is another factor. When first raised, the proposition that nearly all of the material in Europe be left there and the Army re-equipped raised such a furore that the military hastened to modify it to apply only to obsolete and unsuitable equipment. And one of the most intangible but most important factors will be the extent of public pressure, backed by industry, for the resumption of manufacture of vitally needed civilian goods.

The military is reported to be plugging for sustained full production of munitions after V-E day to build up a stockpile for the first several months, after which reconversion could be accomplished all at once. Herein lies the knottiest problem which will have to be threshed out between the Army and the civilian officials. It is assumed that WPB will resist the Army's plan. On the other hand, official estimates of cutbacks after the fall of Germany have ranged from 17 to 23 per cent. Yet WPB knows, as does industry, that such a small cutback will be of practically no value in reconversion in most industries, such as automobile manufacture. To be practical, cutbacks should measure at least 40 per cent before enough plant space can be cleared and enough equipment freed to make production of cars economically possible. The battle most likely will be fought out on this line if it takes all summer—which it probably will.

One aspect of contract termination that is bound to cause great difficulty is the nature of war work held by the various companies. Those making Naval rockets, for example, are likely to find themselves tied up for a long period. This program is slated to be expanded 33 times over the December, 1944, requirements. Certain types of tanks, on the other hand, are likely to be cut back. Thus, one company making tanks may have some advantage over another tied up in rocket production or with some other critically needed item for the Japanese war. While WPB's newly created Production Readjustment Committee will be able to equalize cutbacks to some extent by shifting the load from plants tied up with war work to those having released capacity, practical considerations, such as tooling, training of workers, and requirement of special equipment and facilities, will limit its scope to some extent.

Despite an increase of 22½ per cent in production of liquid-cooled internal combustion engines in 1944, more output of both engines and spare parts is needed this year, according to WPB.

(*Turn to page* 48, *please*)

SAE Organizes Research And Development Group

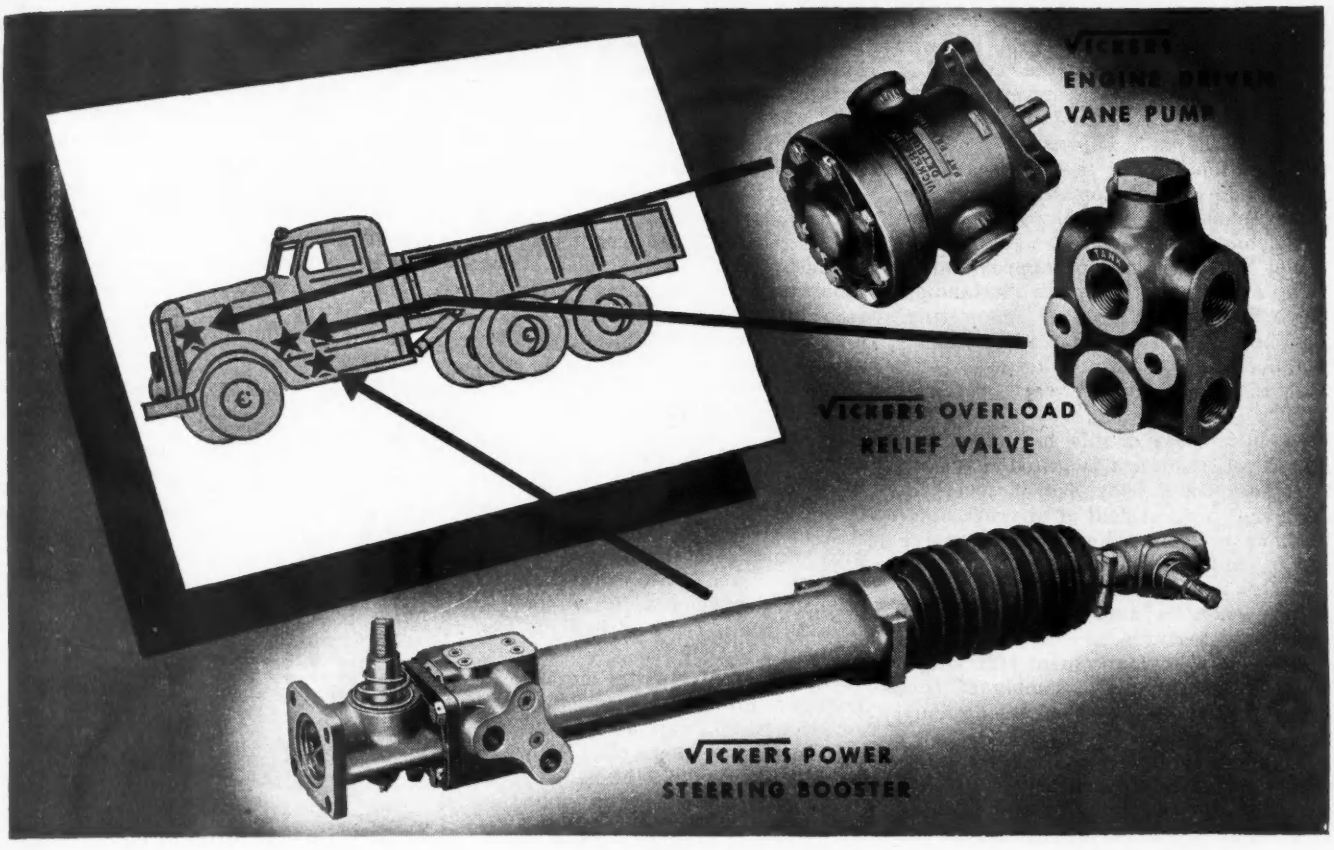
A Special Projects Subdivision of the Aeronautic Division, Society of Automotive Engineers, has been organized to undertake coordinated research and development in fundamental aeronautical engineering fields.

The subdivision already has initiated four projects. They are: development of a standard aeronautical drafting room practice manual; test procedures and design requirements for helicopter powerplants, transmissions, and drive mechanisms; standardization of inspection stamps and symbols used in the aircraft manufacturing industry; and aircraft engine cold starting requirements.

The subdivision's work will be coordinated with continuing projects of the Division's Aircraft Engine, Accessory and Equipment, Propeller, and Materials and Processes Coordinating Subdivisions, which are active in the fields of standardization, recommended engineering practices, and specifications. The new subdivision, however, will concentrate on fundamental engineering research and development problems underlying the work of the other subdivisions.

English Plants Expanded To Handle Export Trade

The Standard Motor Co., one of the four largest passenger car manufacturers in England, has acquired, by lease from the Government, Coventry's biggest "Shadow Factory" with a floor area of 1,000,000 sq.ft. Erected at the beginning of the war, it has been operated by the Standard Co. on behalf of the Ministry of Aircraft Production and has produced large numbers of aircraft engines. By supplementing the existing Standard plant, not far away, it



EASY INSTALLATION . . . Another Feature of

VICKERS HYDRAULIC POWER STEERING

Being compact and requiring a minimum of space for installation, the Vickers Hydraulic Power Steering System can be applied to most existing hand steering mechanisms with a few simple alterations. The separate and compact power cylinder (booster) can be located where it does not interfere with other apparatus and where the power will be applied directly to (and in line with) the drag link. No additional space is required at the end of the steering column where space is usually at a premium.

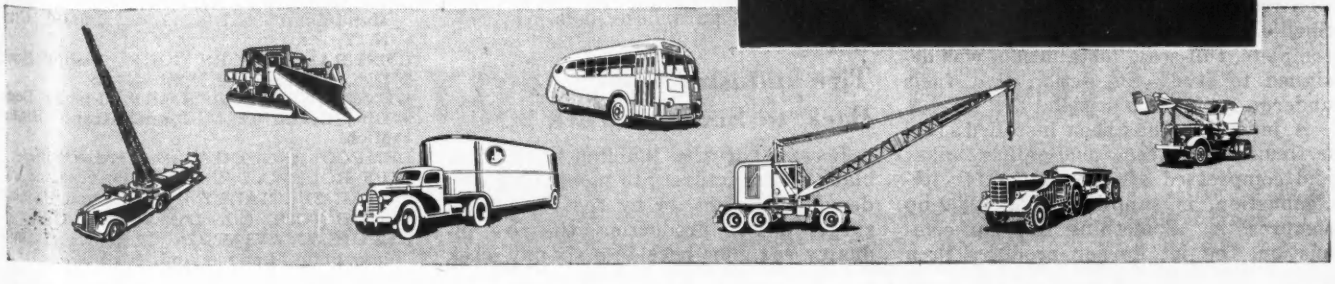
Other important advantages of Vickers Hydraulic Power Steering are: effortless, positive and shockless steering, automatic overload protection, reduced operator fatigue, greater road safety, automatic lubrication, and 14 years of operating experience. Bulletin 44-30 gives complete information about Vickers Hydraulic Power Steering; write for a copy.

VICKERS *Incorporated*

1428 OAKMAN BLVD. · DETROIT 32, MICHIGAN

Application Engineering Offices: CHICAGO • CINCINNATI • CLEVELAND • DETROIT
LOS ANGELES • NEWARK • PHILADELPHIA • ROCHESTER • ROCKFORD
TULSA • WORCESTER

Representative Applications of
VICKERS HYDRAULIC
POWER STEERING



will enable the output of Standard cars to be increased to double the pre-war rate and to augment the output of Triumph cars, which recently have come under Standard control.

One of the main objects of acquiring the additional plant is to increase the production of cars for export, and for this purpose an entirely new export model has been prepared. This special model has an engine of approximately 15 hp and is said to have an outstanding performance for a car of this rating. Passenger accommodation will be much roomier than that usually associated with 15 hp cars; it is, in fact, described as a "full family" car with seating for 5-6 adults. No details have been released yet, though it is stated that both the chassis and body are of novel design, that a great deal of aircraft practice has been embodied, that extensive use is made of aluminum and that an entirely new remote control of the transmission is among the new and distinctive features.

The official announcement states that negotiations for the assembly of this export model in several overseas markets are in progress.

Standard will also produce after the war a light utility vehicle with four-wheel drive and independent suspension that is calculated to appeal to farmers the world over and to meet industrial transport requirements in many fields.

The Dunlop Rubber Co. also has acquired on lease an aircraft factory owned by the Government. It is near Liverpool and has been operated on behalf of the Ministry of Aircraft Production by Rootes, the holding company controlling Humber, Hillman and Talbot cars and Commer and Karrier trucks. In announcing the acquisition of this plant, the chairman of the Dunlop Rubber Co. (Sir George Beharrell) indicated that increased production for export was one of the objects. It was considered better, he said, to acquire this modern plant rather than submit to all the difficulties and delays that would be associated with the extension of existing plants while in full operation. The Liverpool plant is about 90 miles by road from the main existing Dunlop plant at Birmingham.

Laboratory to Study Jet-Propulsion Fuels

A laboratory for the study of fuels and lubricants for jet-propulsion aircraft has been built and put into operation recently at Wood River, Ill., by the Shell Oil Company. The laboratory, a complete, full-scale installation, was designed to study the action that fuels undergo in jet-combustion.

A jet burner has been installed; fuel is furnished by ten 5,000-gallon tanks; and compressed air, necessary for jet-combustion, is supplied by a 1,000-hp compressor. Something new in combustion, the jet burner produces in a much smaller amount of space about 250 times the heat of a residential oil burner; creates a stream of hot gas of greater than hurricane velocity.

Combustion of such a radically new character requires new basic research, and completely new studies of burning characteristics of possible fuels have been undertaken. By means of electrical recording devices located in a sound-proofed control room, the new laboratory is compiling performance records on fuels suitable for use in jet-propulsion and combustion turbine engines.

Obituary

Byron H. Newell, 54, assistant manufacturing manager of Buick Motor Division, died March 12 at Flint, Mich. of a heart attack. Mr. Newell had been with Buick eleven years, coming to Flint as foundry superintendent after extensive experience in the field that included connections with Ford, Dodge, Oakland and Cadillac.

Chester A. McMartin, merchandising manager for the export division of Chrysler Corp., died at Detroit, March 18. He was 56 years old. Before joining Chrysler in 1925, he had been associated with the Maxwell and Durant companies.

Charles F. Cone, Vice-President of the George J. Hagan Company, Pittsburgh, Pa., died suddenly March 15. Mr. Cone was treasurer of the Industrial Furnace Manufacturers Association.

Electronic Process Speeds Curing of Rubber Products

An electronic rubber curing process that is as much as 17 times faster than the conventional steam method was disclosed by The Firestone Tire and Rubber Company.

The process, which has reached the production stage for the first time, is expected to save thousands of man hours and to increase the output of some critical war materials 50 to 80 per cent. These include tank tracks, bogie rollers on which the tracks operate, and rubber wheels for such equipment as industrial tractors and hospital carts.

Use of electronics in Army tank track production is scheduled at the Firestone plant in Noblesville, Ind., while the rubber wheels will be turned out at Fall River, Mass. Electronic equipment also will be used at Fall River in curing foamed sponge rubber for upholstery, airplane seat cushions and parachute pads.

Tire Industry Goes Back to Six-Day Week

Because of the inability of carbon black manufacturers to meet the heavy demand brought on by the recent upsurge in tire production, the tire industry has gone back to a six-day week until the supply of carbon black can be brought up to the point where seven-day operation again will be possible. The seven-day program was inaugurated early in December for a 120-day period in an effort to boost production of military tires. The move was so successful that production in January rose to 1,770,000 heavy tires, 553,000 more than were turned out in October. WPB is attempting to crack the carbon black shortage by increasing manpower in existing plants, opening new facilities in the Southwest, and speeding the production rate.

In view of the existing shortage of carbon black and tire cord, the rubber bureau of WPB has continued indefinitely the freeze order, issued Dec. 23, 1944, as a temporary measure, limiting production of passenger car tires to about 5 million units for the first quarter of 1945.

AWARDS

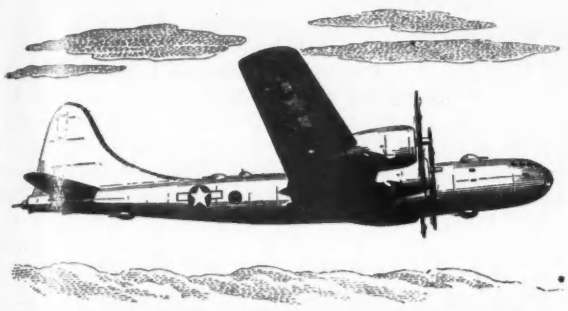
Names of winners of Army-Navy "E" awards in or allied with the automotive and aviation industries announced since the Mar. 15 issue of AUTOMOTIVE *and* AVIATION INDUSTRIES went to press:

AMERICAN STEEL & WIRE CO., Duluth Plant, Duluth, Minn.
THE BISHOP AND BABCOCK MANUFACTURING CO., Plants No. 1 and No. 2, Cleveland, Ohio
CHANDLER-EVANS CORP., South Meridian Plant, South Meridian, Conn.
THE OHIO CRANKSHAFT CO. and OHIO CRANKSHAFT, INC., Cleveland, Ohio
SAGINAW BODY MANUFACTURING CO., Saginaw Plant, Saginaw, Mich.
SUPERIOR COACH CORP., Lima, Ohio
UNITED STATES PLYWOOD CORP., Algoma Plant, Algoma, Wis.
UNITED STATES PLYWOOD CORP., New Rochelle Plant, New Rochelle, N. Y.
UNITED STATES RUBBER CO., Passaic Plant, Passaic, N. J.
WARWICK MANUFACTURING CORP., Chicago, Ill.

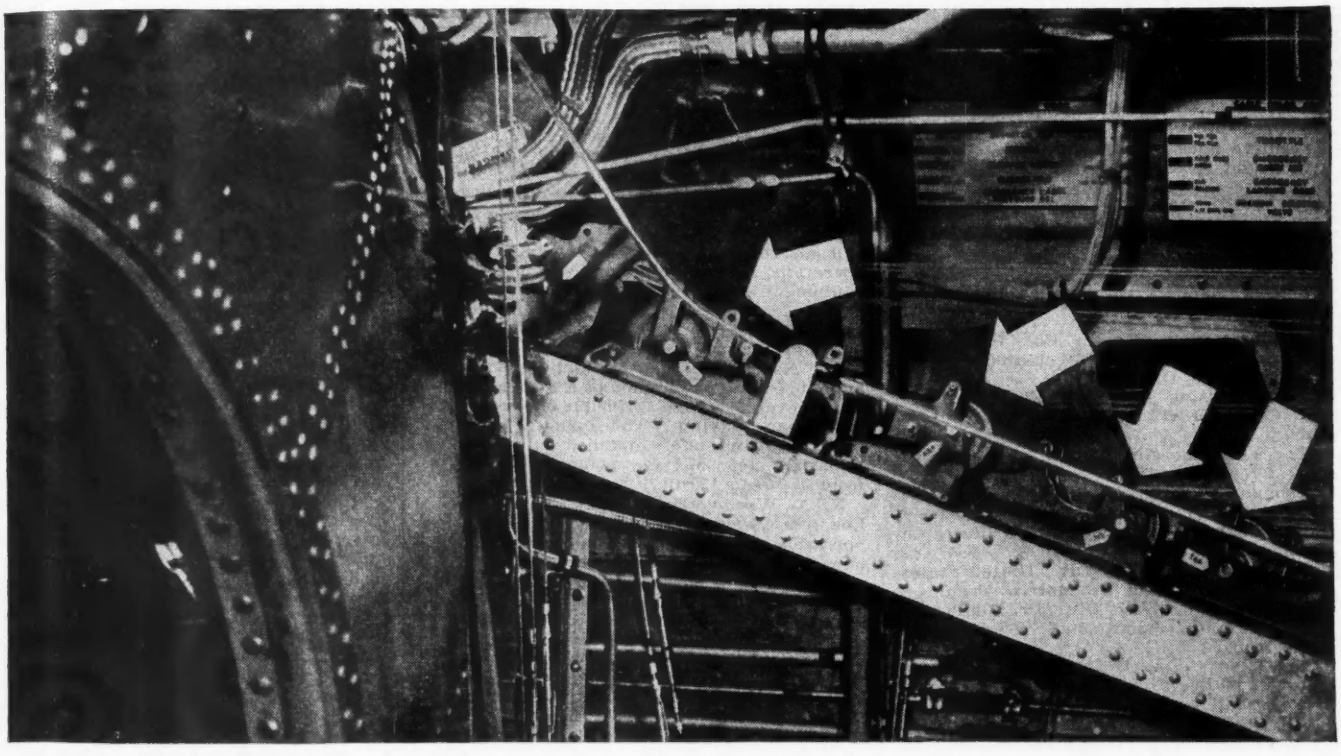
★ "E" Star Awards ★

for continuous meritorious services on the production front have been awarded to the following firms:

BLACK & DECKER MANUFACTURING CO., Towson, Md.
DELTA MANUFACTURING CO., Milwaukee, Wis.
ECLIPSE COUNTERBORE CO., Ferndale, Mich.
THE ELECTRIC AUTO-LITE CO., Metal Manufacturing Div., Long Island City, N. Y.
GENERAL MOTORS CORP., Fisher Body Div., Flint Plant, Flint, Mich.
GENERAL MOTORS CORP., Fisher Body Div., Grand Blanc Plant, Grand Blanc, Mich.
LEMPCO PRODUCTS, Bedford, Ohio.
LIPE-ROLLWAY CORP., Syracuse, N. Y.
METAL SPECIALTY CO., Cincinnati, Ohio
PLOMB TOOL CO., Los Angeles, Cal.
REPUBLIC AVIATION CORP., Farmingdale Plant, Long Island, N. Y



450 Control Pulleys on B-29 Superfortress Ride on Needle Bearings

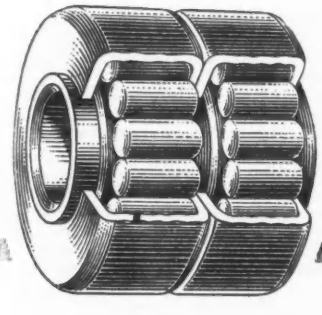


Torrington double-row Needle Bearings assure smooth functioning of B-29 control pulleys.

When you're carrying the world's greatest bomb load higher, faster and farther than any other plane in existence, you want the 450 pulleys your control cables ride on to function smoothly, efficiently, and reliably.

That's why, aboard Boeing's great B-29 Superfortress, each control pulley turns on a Torrington PN type anti-friction Needle Bearing. Torrington Needle Bearings are utilized because they more than meet all the requirements for lightness, compactness, high load capacity, stability, ease of anti-friction operation—*and all-out reliability.*

Detailed data on this and other applications of Torrington Needle Bearings is available for your engineering files. You'll find it helpful in solving many a problem of friction elimination that comes to your drawing board. Send for your copy today.



THE TORRINGTON COMPANY

TORRINGTON, CONN. • SOUTH BEND 21, IND.

New York Boston Philadelphia Detroit Cleveland Seattle Chicago San Francisco Los Angeles Toronto London, England

TORRINGTON NEEDLE BEARINGS

PERSONALS

Recent appointments among automotive and aviation manufacturers:

Chevrolet, Motor Div., General Motors Corp., **Edmond H. Colliau,** Asst. Adv. Mgr.

DeSoto Div., Chrysler Corp., **Karl H. Bronson,** direction of the advertising and sales promotion activities.

Willys-Overland Motors, **Charles Cuma,** Chief Design Engineer on Engines.

Worthington Pump & Mch. Corp., **George Steven,** Executive Engineer of Buffalo Works.

Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp., **Ralph S. White,** Manager, Engineering Development.

Federal-Mogul Corp., **Guy S. Peppiatt,** Executive Vice-Pres., charge of manufacturing and related activities.

Deepfreeze Div., Motor Products Corp., **G. H. Smith,** Vice-Pres. and Gen. Mgr.

Russell Mfg. Co., **Carl J. Sherer** and **Amor P. Smith,** Directors.

K-D Lamp Co., **A. E. Snyder,** Commercial Vice-Pres.

Allis-Chalmers Mfg. Co., **John H. Collier,** Director.

The Glenn L. Martin Co., **Robert H. Kittner,** Manager of newly created Plastics and Chemicals Div.

Merchandising Div., The Electric Auto-Lite Co., **L. B. O'Loughlin,** Trade Relations Mgr.

The Firestone Aircraft Co., **John L. Cohill,** President, **D. W. Anderson,** Vice-President.

Bendix Radio Div., Bendix Aviation Corp., **Arthur C. Omberg,** Chief Research Engineer.

Naugatuck Chemical Div., United States Rubber Co., **Harold B. Morris,** Technical Representative. Tire Div., **Dr. Sidney M. Cadwell,** Asst. General Mgr., headquarters at Detroit.

Synthane Corp., **Dr. Norman A. Skow,** Director of Research. Formerly with Bakelite Corp.

ACF-Brill Motors Co., **Mark C. Pope,** District Sales Mgr., Southeastern District, headquarters at Atlanta, Ga.

Anthony Co., **C. H. Worrells,** formerly Treas., now General Sales Mgr. **Glenn A. Duis,** Executive Vice-Pres.

Siewek Tool Div., Domestic Industries, Inc., **Edward H. Grumlich,** Vice-Pres. chg. of manufacturing and plant operations.

Federal Machine & Welder Co., **John E. Ponkow,** Sales Mgr.

Detroit Broach Co., **David A. Nelson,** Vice-Pres. and General Mgr.

Superior Steel Corp., **Eugene J. Reardon,** Vice-Pres. and Director.

Du Pont Has Received 100 "E" Awards and Stars

The Du Pont Company has passed the 100-mark in "E" awards and stars for war production. In all, 33 plants have received the "E," and a total of 70 stars have been conferred.

PUBLICATIONS

Bulletin F-428 has been published by Fansteel Metallurgical Corp., describing Fanweld, a non-ferrous hard-facing metal intended for acetylene torch application to steel. Detailed information and prices are given in the bulletin.*

New catalog sections on its fractional hp and Muti-V belts have been published by The B. F. Goodrich Co. The sections describe construction of the belts and list standard belt dimensions and interchangeability tables.*

Sciaky Bros. has issued Bulletin 113-A describing series PMM-1 180 KVA **Seam Welders.** General information and tooling data are included in the bulletin, together with machine specifications.*

John S. Barnes Corp. has issued a new bulletin, No. 501-P, describing and illustrating **Barnes custom-built hydraulic presses.***

Sundstrand Oil Power Transmission for Variable Speeds is the title of a new bulletin by Sundstrand Machine Tool Co. It illustrates and describes the operating principles, features, possible applications and gives engineering data on Sundstrand Oil Power Transmissions.*

The Research Institute of America has published a booklet, **Rehiring Your Company's Veterans.** It is Analysis 38 and copies may be had by writing the Institute, 292 Madison Avenue, New York 17.

Detroit Broach Company has published a **Manual of Broaching** covering the design and usage of all types of internal broaches, face plates and broach pullers; a general discussion of the principles of surface broaching, with many examples and including a section on fixtures, broach holders and inserts. A section is devoted to the operation and maintenance of broaching equipment, including broach sharpening. Copies may be had from Detroit Broach Co., 20201 Sherwood, Detroit 12. The price per copy is **$1.50.**

The National Broach & Machine Co. has announced the publication of a 16-page bulletin devoted to the principle of **crossed-axis gear shaving.** The bulletin is well illustrated and offers detailed information regarding gear shaving machines in sizes from 36 in. to 120 in.*

N. A. Woodworth Co. has issued Cone-LokJig Catalog 45-J, which illustrates the operation of the **Cone-Lok** and explains six new features embodied in the Jig; maximum safety, mechanical simplicity, rugged construction, adaptability, chip protection and sealed lubrication. Several pages are devoted to data sheets and dimensional drawings of the three styles now manufactured, the **up-clamp,** the **bridge,** and the **3-post-type jigs.** Three new gage developments are also described in the catalog.

An illustrated catalog has been published by American Foundry Equipment Co. describing its complete line of **Airblast** equipment, including rooms, cabinets, tanks, suction guns, nozzles and accessories.*

Shakeproof, Inc. has issued a bulletin on **quick fasteners,** titled Shakeproof Application Bulletin, which illustrates a number of practical uses for these fasteners.*

Pesco Products Co., Div. of Borg-Warner, has published a new Aircraft products folder illustrating and describing **air, fuel** and **hydraulic** equipment and related products.*

* Obtainable by subscribers within the United States through Editorial Dept., AUTOMOTIVE *and* AVIATION INDUSTRIES. In making requests for any of these publications, be sure to give date of the issue in which the announcement appeared, your name and address, company connection and title.

Sharp Increase in Synthetic Rubber Program

A sharp increase in the 1945-46 program for production of synthetic rubber in the United States is necessary in order to meet military and essential civilian transportation requirements, according to an announcement by the Rubber Reserve Company, a subsidiary of the Reconstruction Finance Corporation.

At the same time, the Rubber Reserve Company reported that United States production of synthetic rubber in 1944 totaled 763,255 long tons, a figure exceeding the average annual tonnage of natural rubber consumed in this country during the pre-war years 1937-41, inclusive.

Production scheduled for 1945 is, in round figures, 1,000,000 tons or 31 per cent more than last year, and for 1946, 1,200,000 tons, or 58 per cent above 1944 production. These amounts exceed average annual world consumption of rubber in the ten years preceding the outbreak of the war. Largest world consumption for any pre-war year was 1,108,000 tons in 1939.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Moderate recession in business activity is indicated by current reports. The *New York Times* index for the week ended March 3 stands at 142.3, as against 146.3 for the preceding week and 144.8 for the corresponding period last year.

Electric power production in the week ended March 10 was slightly smaller than in the preceding week but 0.5 per cent larger than in the comparable period last year, as against a similar gain of 0.2 per cent a week earlier.

Railway freight loadings in the week ended March 3 totaled 785,264 cars, which is 1.7 per cent above the figure a week before but 0.2 per cent below that for the similar period a year ago.

Crude oil production for the week ended March 10 averaged 4,770,750 barrels daily, which is 7050 barrels above the figure for the preceding week. Production increased in all areas except East Texas, Illinois and Michigan.

Production of soft coal in the week ended March 3 is estimated at 11,350,000 net tons, as against 11,925,000 tons a week earlier and 12,115,000 tons a year ago. Output for the year to date totals 104,795,000 tons, as compared with 114,964,000 tons for the corresponding 1944 period.

Engineering construction contracts awarded during the week ended March 15, according to *Engineering News-Record,* totaled $40,763,000, which is 3 per cent below the figure for the preceding week but is 18 per cent above the average for the four weeks preceding and 38 per cent above the total for the corresponding week last year.

After reaching a new high mark at 115.06 per cent of the 1926 average during the week ended March 2, the Irving Fisher index of wholesale commodity prices declined fractionally to 114.86 in the following week. The current figure compares with 112.84 a year ago.

Member bank reserves declined $20,000,000 during the week ended March 7, a decrease of $172,000,000 in Treasury deposits with the Reserve banks being more than offset by a number of other changes, the most important of which were a rise of $114,000,000 in money in circulation and a decline of $52,000,000 in the gold stock. Excess reserves were estimated at $900,000,000. During the same period, earning assets of reporting member banks declined for the seventh consecutive week, with a decrease of $53,000,000 in commercial, industrial and agricultural loans.

The CONE AUTOMATIC MACHINE COMPANY sees many GOOD THINGS AHEAD

It is reported that . . . . . .

New ideas in highway busses include: separate engines for each driving wheel, hydraulic transmission, increased use of aluminum, 50 passenger capacity, two decks, wider treads and steam power. *Business Week.*

get ready with CONE for tomorrow

A new process deposits a ceramic insulating covering on electric wire. *Sprague Electric Co., N. Adams, Mass.*

get ready with CONE for tomorrow

A new storm-proof wire for rural electrification is made of steel wire covered with copper. *American Steel & Wire Company.*

get ready with CONE for tomorrow

About 10% will be added to the country's cold storage capacity if plans to use a 12 million cubic foot limestone mine for that purpose are successful. *Food Industries.*

get ready with CONE for tomorrow

"Molecular distillation" is now out of the laboratory stage and promises to do such incredible jobs as to separate fish oil from its smell. *McGraw-Hill Overseas Digest.*

get ready with CONE for tomorrow

A hardware wholesaler carrying 50,000 items plans to set up a chain of "cafeteria style" hardware stores after the war. *George Worthington Co., Cleveland.*

get ready with CONE for tomorrow

Claims for the new home heater developed by the Bituminous Coal Institute include: one-third reduction in fuel use, 50 hours of heat in one stoking, cost under $100. To parallel this development, Anthracite Industries Inc. has a furnace 2 x 3 x 3 feet that weighs only 75 pounds. It consists of a tube with the coal entering at one end and ashes forced out at the other. *Coal Age.*

get ready with CONE for tomorrow

A new surgical lamp projects a cone of ultraviolet radiation, through which germs cannot pass, around the wound. *Hanover Chemical & Mfg. Co.*

One of the large oil companies announces a motor lubricant claimed to be unaffected by temperatures from 100 below to 200 above zero. *Cities Service Oil Co.*

get ready with CONE for tomorrow

A new stirring device is driven by an extended motor that revolves the internal rotor by magnetic attraction. *Ohmite News.*

get ready with CONE for tomorrow

A large trucking company, operating in eleven states, plans to add air freight service as soon as planes are available. *All States Freight Inc.*

get ready with CONE for tomorrow

A chemical company has produced a solution which, it claims, will prevent runs in stockings and may be applied with a sponge. *Monsanto Chemical Co.*

A flashlight, in which battery, bulb, and lens are cast in a cylinder of wax, is said to be cheap enough to throw away when its batteries are exhausted. *Geyaun Manufacturing Co., Charlestown, Mass.*

get ready with CONE for tomorrow

The electron micro-analyzer reports on the atomic composition of particles too small to be seen by microscopes. By its use the point of a common pin can be made to look as vast and rough as a mountain range. *Optical Society of America.*

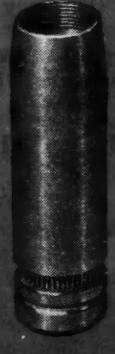
get ready with CONE for tomorrow

In war planes the present type of engine is twice as efficient as jet propulsion at 150 miles per hour; the two are equal at 300 miles; and at 550, jet propulsion is twice as efficient. *EMPIC No. 7.*

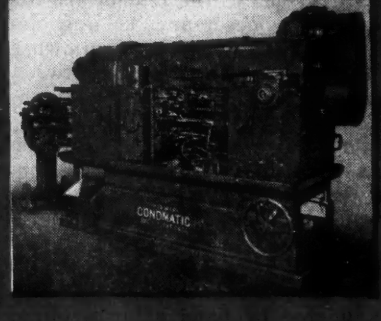
get ready with CONE for tomorrow

Steam busses, now being designed, appear to have many advantages, including smooth operation, no idling, no fumes, low operating cost, engine braking, and longer service between overhauls. *Bus Transportation.*

Automatic Production at automatic-cannon speed



The 1⅝" 8-Spindle Conomatic produces these 20mm. tracer bullets in 8 seconds each. Production like this keeps shell supplies ahead of the requirements of rapid firing guns. Conomatics, in wartime, are a military necessity — in peacetime, an economic necessity.



CONE

AUTOMATIC MACHINE CO., INC. ★ WINDSOR, VERMONT, U. S. A.

16

No Immediate Cutbacks Seen When War in Europe Ends

(*Continued from page* 42)

A four-point program has been planned to meet the problem. It includes further controls on engine scheduling, closer screenings of orderboards to eliminate less essential orders, tightening of controls over distribution of spare parts, and early construction of new facilities. Engines produced by a manufacturer as part of his authorized end product would be excluded. Stricter controls over spare parts are required because in some cases spare parts have been purchased and assembled into engines for less essential needs. More than 300,000 short block assemblies have been sold as spare parts, officials report.

The War Department has permitted disclosure of sketchy details of the new T-26 General Pershing tank which has been in action on the Western Front. Weighing 43 tons, the tank, made by the Detroit Tank Arsenal of the Chrysler Corp. and the Grand Blanc plant of Fisher Body Div. of General Motors, features heavier armor, wider tracks for high flotation over soft terrain, a 90 mm high velocity gun, and torsion bar suspension. It is powered by a Ford V-8 liquid-cooled tank engine which develops 500 hp. The T-26, already dubbed the "Tiger Tamer," is said to be faster than any other big tank in existence.

Studebaker Corp. will expand production of the Weasel, track laying personnel and cargo carrier, about 50 per cent starting April 1, and will boost military truck output about 15 per cent at the same time. The company also will make available all engineering and manufacturing data and will supply Studebaker Champion engines to Ford Motor Co., which will begin manufacture of the Weasel July 1 at its Somerville, Mass., plant.

Grizzly to Make Friction Products Exclusively

Grizzly Manufacturing Company, which just previous to the outbreak of the war went into production in its new brakelining plant at Paulding, Ohio, now announces the sale of its Rubber Division in Los Angeles to the Thermoid Company of Trenton, N. J. It is stated that by this transaction, Grizzly withdraws from oil field activity.

Grizzly personnel will remain unchanged, according to Joe Brown, general sales manager, but from now on, will concentrate all of its engineering, manufacturing, and marketing effort on automotive and industrial friction products, friction blocks, brake linings, and clutch facings, continuing to maintain manufacturing and warehouse facilities on the West Coast as well as present warehouse facilities in St. Louis, Atlanta, and New York.

Three-Point Support for Assembly Fixtures

(*Continued from page* 37)

The factor that probably has contributed most to the success of this type of construction is the simplicity with which large fixtures can be built that will maintain their accuracy even though they are not located on a solid foundation. A large part of the work involved in constructing fixtures of this type can be accomplished by comparatively unskilled labor, as it is not necessary to hold a tolerance closer than plus or minus ¼ in.

First, sufficient angles or attaching plates are welded to the framework for supporting all necessary holding devices and locating points, allowing from 1/16 in. to ½ in. space between the base plates and the fixture attaching angles. After all welding is completed on the framework, it is desirable, but not necessarily essential, to normalize the fixture to release any possible welding strain. However, this is not always possible due to the size of the fixtures. If a close fit is maintained on all joints and the weld seams are hammered by hand after welding, the fixture will usually be through shrinking by the time it is necessary to locate and set the final points.

The use of a jig builder's transit at Ryan has provided a considerable savings in time in setting up and establishing center lines and critical points. It has practically eliminated the old time-consuming method of stringing horizontal and vertical wires. Where formerly six to eight hours were required to set up these lines, it now takes approximately 20 minutes. It is essential, however, that the transit be designed to work to close tolerances at short range.

All of the critical holding devices and locating points can be installed after the framework is complete and set up on the base without fear that the additional work will cause distortion or misalignment of the fixture. The holding devices and locating points, which have been previously machined and assembled on the base plates, can be set in their respective locations on the frame of the fixture and properly located with adjustable screws. When all holding devices and locating points are set and inspected, the 1/16 in. to ½ in. space is filled with Cerromatrix to permanently locate and provide a substantial base.

Some people may decide that this type of fixture construction is limited to small assemblies. However, this is not the case, as it has already proven very satisfactory on production of large wing and center section assemblies. In these cases as large as 22 in. diameter pipe with bulkheads welded inside at regular intervals was necessary to provide sufficient strength for the base. These fixtures are much superior to previous design in that they can, in most cases, be designed in such a way as to make it unnecessary to disassemble and remove portions of the fixture in order to remove the completed assembly.

This type of construction also makes it possible to use lighter material. The use of three supporting points eliminates the necessity of having to construct a special foundation or bolt the fixture to the floor and level it, as is the case when supported on four or more points. A fixture with four or more supporting points has a tendency to introduce strains or twists into the assembly, as its weight alone is usually enough to cause distortion when set on an uneven floor. Where it is necessary to have an assembly jig rotate to facilitate construction of the assembly, the use of a trunnion supporting fixture supported on three points has proven much more satisfactory than the old type which was bolted to the floor.

Since the beginning of the war the aircraft industry has been faced with the ever increasing problem of expansion in order to provide sufficient quantities of airplanes. When production lines were set up and established for a certain quantity, the job was scarcely finished before it was necessary to expand to meet increased schedules. Many man-hours have been lost due to the problems involved in moving fixtures and equipment to take care of this expansion. In some cases many man-hours were lost because it was considered more economical to expand around certain fixtures that were fastened to the floor or set on special foundations, than spend the necessary time to reset these fixtures on new foundations. This situation created congestion or "back-tracking" of assemblies, which could be prevented if it were possible to move these fixtures to their proper location in the assembly line.

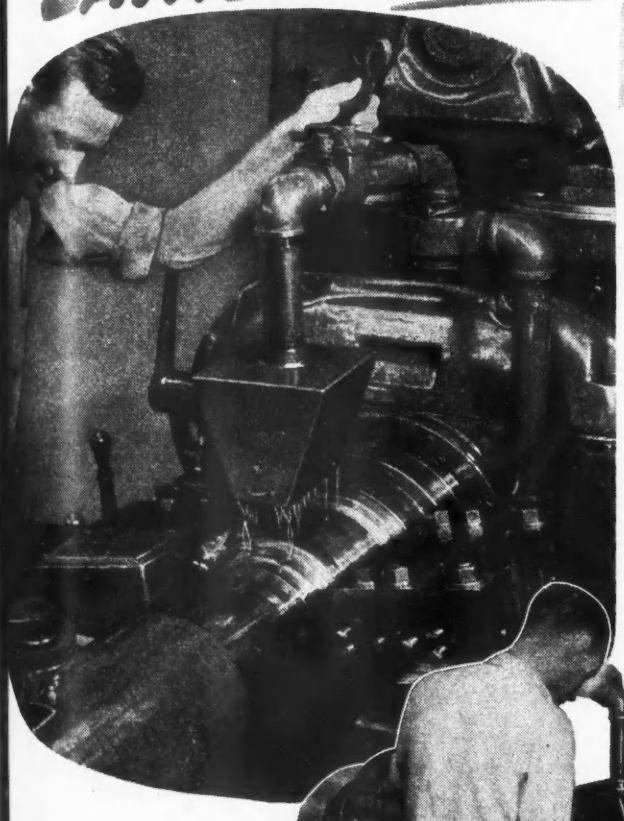
The use of fixtures with three supporting points here at the Ryan plant has made possible a savings of many man-hours in this respect alone as it is possible to move these fixtures from one location to another without having to prepare a special foundation or without having to level and check them after they are located. Thus production bottlenecks due to improperly located fixtures are eliminated with a minimum amount of effort. Many pages could be written outlining the advantages of the three-supporting-point type of fixture construction. However, it is not possible to fully realize all the advantages until they are actually being used.

LODGE & SHIPLEY LATHES at work

20 HOURS DAILY

FOR OVER 14 MONTHS . . .
NO MAJOR OVERHAUL
OR REPLACEMENT

AT KINNER MOTORS, INC.



● The astonishing production records obtained with the Duomatic could not be achieved without its unusual durability and freedom from costly downtime. Month after month, dependable performance of Duomatics has helped Kinner Motors establish new highs in finning cylinder barrels for aircraft engines.

Here, the Duomatic—a full automatic lathe—is finning a Wright 1820 nitroloy cylinder barrel, using a speed of 18 RPM with feed of .007 inches. About 20 lbs. is removed from each barrel in one operation. As many as 105 cylinders have been turned per grind of tools.

The Duomatic saves manpower, too. So simple are its automatic controls, that at Kinner one operator attends two Duomatics—affording added savings with NO LOSS IN PRODUCTION!

Remarkable as these results may seem, L & S Engineers will gladly demonstrate how the Duomatic can perform with equal efficiency in your plant — whether large or small. Write on your company letterhead for detailed bulletin No. 601.

DO IT WITH A DUOMATIC

THE LODGE & SHIPLEY MACHINE TOOL CO.

CINCINNATI 25, OHIO, U. S. A.

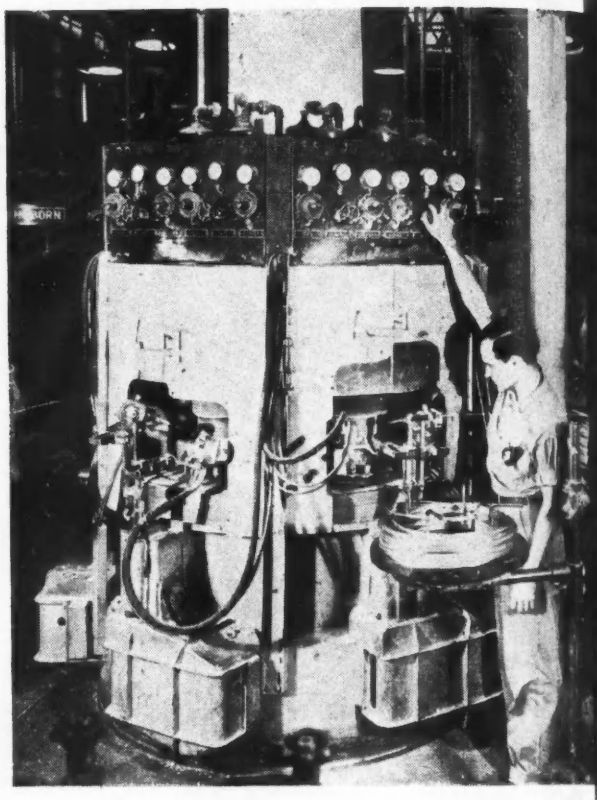
L & S LATHES

ENGINE — TOOL ROOM — AUTOMATIC — OIL COUNTRY LATHES

Automatic Metallizing Machine

EQUIPPED with a rotating table and six fixtures, this metallizing machine, which is used to apply a .002 or .004 in. aluminum coating on cylinder head and barrel assemblies for Chevrolet-built Pratt & Whitney aviation engines, is said to be capable of producing a completed assembly approximately every 40 seconds. This thin coating has been found adequate to protect them from the corrosive effects of extreme weather conditions.

Before loading in the machine, the surface is degreased by immersion in a solvent vapor and then roughened by sand blasting. The metallizing operation is done automatically in three stations—the assembly rotating slowly while the metallizing gun travels vertically. One station is used to hand spray scavenger oil lines. Eleven gage aluminum wire is fed through guns of the metallizing machine at the rate of 4¼ to 4¾ ft per min. Oxygen is supplied to the guns from a battery of oxygen cylinders which are replenished when necessary, and so arranged that an empty cylinder can be replaced without shutting off the flow of oxygen. Pressure is regulated at 28 to 33 psi. Air, under pressure of 60 to 65 psi, is supplied through a special system which removes all moisture. Compressed natural gas is supplied to the guns at a pressure ranging from 26 to 30 psi.



B-29 DATA

THE following engineering data and descriptive information on the B-29 Superfortress have been released by the AAF Air Technical Service Command, Wright Field:

B-29 Superfortress is an all-metal, mid-wing monoplane with single-tail and retractable, dull-wheel, tricycle landing gear. Powered by four 2200 hp., 18-cylinder, Wright Cyclone engines each equipped with dual sets of turbo superchargers. Each engine drives a 4-bladed, 16.5 ft. Hamilton Standard propeller. Auxiliary power plant, rear of fuselage used primarily as self starter for the main engine.

Wing Span: 141.3 ft; Length: 99 ft; Height: 27.9 ft; Tail Fin: Single—27.75 ft. high; Tread Width: 31.5 ft; Wing Area: 1739 sq ft; Weight: Approx 120,000 lb; Speed: Over 300 mph; Landing Speed: About 100 mph; Ceiling: Over 35,000 ft; Range: Approx 3600 miles; Bomb Load: Up to 10 tons; Crew: 11 men, including 5 gunners; Armament: 10 or 12 x .50 cal.

Electric Motors: 152 of 49 types. A Lawrence Aeronautical Corp. 12-hp auxiliary gasoline engine gives extra power for operation of gear in takeoff and landing; Wiring: 11½ miles.

Pressurized Cabins: From sea-level to 8000 ft inside pressure is the same as outside pressure. From 8000 to 30,000 ft, regulators maintain constant 8000 ft pressure. Above 30,000 ft, a 6.55 psi differential is maintained between the internal and the external air pressure. For example, a cabin pressure equal to that at 10,200 ft is maintained at altitude of 35,000 ft.

Wing: Boeing "117" airfoil. Dihedral of wing is 4½ deg, and there is a 7 deg sweepback. Inboard portion of the wing employs 3/16 in. Alclad. Aspect ratio of wing is 11.5. Maximum wag on the wing tip in flight is 48 in. as compared with 30 in. on the B-17.

Flaps: Fowler type. Equal to 1/5th of the wing area. Flaps extended 25 deg on takeoff. In extended position they increase wing area 19 percent. Using additional flap in landing, the B-29 "sets down" with speed comparable to B-17.

Rudder and Ailerons: Direct actuating controls operated without benefit of booster system.

Propeller Reduction Gear: Ratio 0.35 to 1.

Electronic Pilot: Can make over 300 flight corrections per minute.

Number of parts: 55,000, exclusive of rivets. Engine has 900 parts.

Remote and Central Fire Control System: General Electric. Employs new secret automatic fire computor to bring greater fire power on any target, at greater distances, than any other bomber.

Landing Gear: Dual-wheel, retractable tricycle—retracts electrically. Weight totals slightly more than 7000 lb—6000 lb for main gear, 1000 lb for nose wheel.

Wheels: Nose, 36 in. diam. Main undercarriage, 56 in. diam. Tires on main undercarriage, Goodyear 16-ply Nylon S.C. synthetic tread. Same size as those on B-2[illegible] and B-17.

Brakes: Operated by a hydraulic boo[illegible] (only hydraulic device on plane).

Wing Center Section: Weighs 11 ton[illegible] minus engines.

Aluminum: Totals 50,000 lb.

Rubber: Totals nearly 5000 lb; 200 rubbe[illegible] parts, including fuel tanks.

Bombsight—Norden.

Automatic Pilot—Minneapolis-Honeywe[illegible]

Historical Facts

First inspection of full-size, all-woo[illegible] mock-up made by AAF, November 1940.

First four XB-29s under construction[illegible] January, 1941.

XB-29 Flown for first time Septembe[illegible] 14, 1942, by Eddie Allen.

First Production Model B-29 complete[illegible] July, 1943, at Wichita.

First Tactical Mission—June 5, 1944, ov[illegible] Bangkok, Thailand.

First raid over Japan—June 15, 1944.

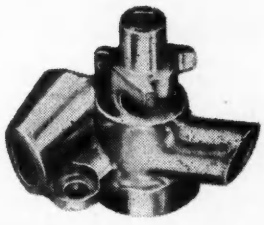
First engine built in 1937. First tested [illegible] Wright Field June 29, 1938. Submitted [illegible] Materiel Command for acceptance in 194[illegible]

Cost: First B-29 cost $3,392,396.90. Cu[illegible] rent production models cost approximate[illegible] $600,000.

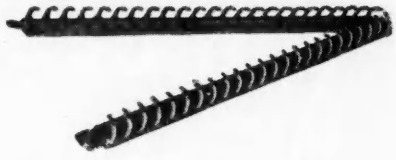
Engineering changes: 900 in XB-29; [illegible] more before first production model w[illegible] completed; 30,000 engineering changes ma[illegible] in engine before final design.

B-29 Mfgs: Boeing, Wichita, Kan.; Re[illegible] ton and Seattle, Wash.; Bell, Marietta Ga.; Glenn L. Martin, Omaha, Neb.

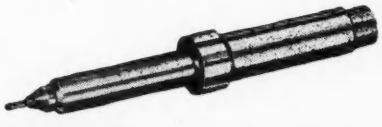
You Get Corrosion Resistance *Plus* EASY, ECONOMICAL FABRICATION with Carpenter Stainless



LOWER UNIT COSTS This aircraft fuel supply valve body was forged from Carpenter Stainless #8 (Type 303) forging bars. Our *machine-turned* billets from which all Carpenter Stainless forging bars are rolled, assure freedom from surface defects. The result: sound, flawless forgings for you, with minimum rejects.



SAME DIES as were previously used to form and blank ordinary cold rolled strip, later made this ingenious Stainless loose leaf binder. Ductile, uniform Carpenter Stainless #6 (Type 430) assured clean stamping, easy crimping, smooth bends. In addition, this satin-finish Stainless eliminated all polishing operations.



AUTOMATICS USED This airplane part, machined in automatics from Carpenter Stainless #8 (Type 303) bar stock, indicates what can be done with Free-Machining 18-8 Stainless.

● When you consider putting new zest, greater "eye" appeal into your new or redesigned products —when you consider giving them greater strength and a higher factor of safety—when you consider endowing them with special physicals to meet unusual service conditions — the first thing that comes to mind is "Let's make it from Stainless."

But beyond these immediate sales and utility advantages, you want Stainless Steels that will work with you right from the start. Easy-working Carpenter Stainless Steels, for instance, can help your shop get into production faster. Because they form easily, blank cleanly and permit faster press and machining speeds, they smooth the way from drawing board to finished product. In addition, these Stainless Steels save time and expense in the finishing room.

Carpenter has spared neither time nor expense to bring you the easiest-fabricating Stainless Steels that ever hit your production line. The same group of stainless experts who helped make possible ductile, easy-working Stainless Strip and Free-Machining Stainless bar stock are ready to apply their experience to your problems. Let them help you select the proper Stainless for the job. Let them help you cut corners and costs in your fabricating shop.

Call in your nearby Carpenter representative now, or write us at the mill. And if you do not already have a copy, send for our 98-page book, "Working Data for Carpenter Stainless Steels." A note on your company letterhead, indicating your title is all that is necessary.

Give Your Products These Advantages

- Sales Appeal
- Weight Saving
- Ease of Assembly
- Freedom from Rust
- Everlasting Beauty
- No Plating to Peel
- Strength and Rigidity
- Fewer Service Complaints

The Carpenter Steel Company • 103 W. Bern Street • Reading, Pa.

Carpenter STAINLESS STEELS

...for
Strength
Rigidity
Heat Resistance
Corrosion Resistance
Longer Product Life
Sales Appeal

BRANCHES AT
Chicago, Cleveland, Detroit, Hartford, St. Louis, Indianapolis, New York, Philadelphia

New Products for Aircraft

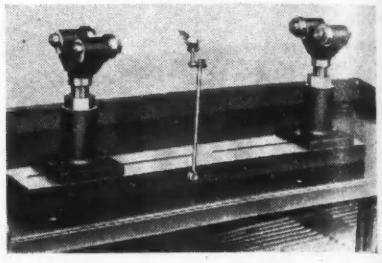
Glass-Base Plastic with High Fire Resistance

The Formica Insulation Company, Cincinnati, Ohio, is now producing a glass-base plastic made in sheets, known technically as glass melamine laminate, made from a fine weave, continuous filament fiber-glass fabric with melamine thermosetting resin, which is more resistant to flame and to arcing than resins ordinarily used in standard grades of laminated material.

The company disclosed that the material available now in sheets, tubes and rods is specially designed for electrical applications which require a high order of flame and fire resistance, together with a high arc resistance and high mechanical strength.

Aligning Fixture for Crankshafts

The Amsco Model PA 156-B crankshaft aligning fixture is designed by the Airplane Manufacturing and Supply Corp., North Hollywood, Cal., to check the alignment of crankshafts of aircraft engines not designed with the internal spline feature. It is used also for checking the alignment of propeller shafts and assembled aircraft engine crankshafts. When in the fixture, a crankshaft is always free to rotate for concentricity checking.



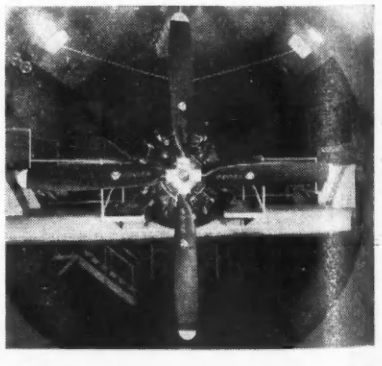
Amsco crankshaft aligning fixture

The Amsco fixture is 36 in. long, 13 in. wide, and measures 13 in. to the top of the bearing-mounted V-blocks.

One Pass Soil Stabilizer

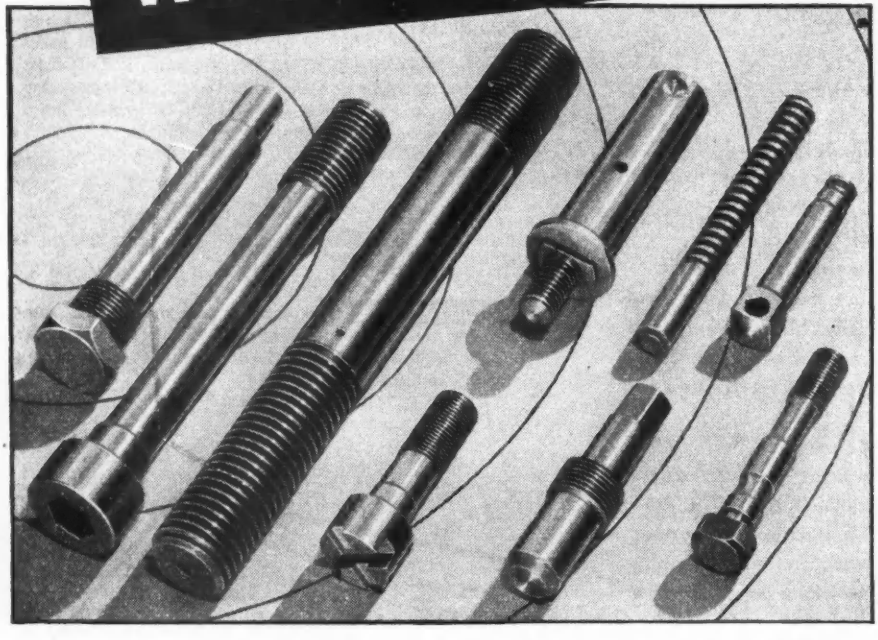
Faster, more economical construction of airport runways, parking lots, etc., is promised by an entirely new soil stabilizer just announced by the Harnischfeger Corporation of Milwaukee, Wis. Known as the P&H single pass Stabilizer, this machine is said to permit efficient, on-the-spot processing of native soils, combining in one operation all the necessary functions in soil preparation.

Testing Aeroproducts' New Propeller



This 12-ft. 7-in. diameter Aeroprop harnesses a Pratt and Whitney R-2800-C engine in one of the test stands of Aeroproducts Division, General Motors Corporation, at Dayton, Ohio. These paddle blades are used on regular production models of Aeroprops built for three of the fastest single engined Army and Navy fighter planes.

YOU DESIGN 'EM
WE'LL MAKE 'EM



Versatile, exacting, efficient—yes, we admit that we are all of these and more . . . In developing a source of supply for screw machine products, you can counsel in confidence with The Chicago Screw Company.

For almost three-quarters of a century we have excelled in producing precision-made screw machine products. The "Know How" accumulated over these long years of experience has resulted in an organization that is exceptionally well qualified to help you with your present problems and post-war developments . . . If your requirements run into hundreds or millions of pieces, regardless of size, shape or material — *you design 'em, we'll make 'em.*

ARMY E NAVY

THE CHICAGO SCREW CO.
ESTABLISHED 1872
1026 SO. HOMAN AVENUE CHICAGO 24, ILL.

Inspecting cylinder finning tools in the Wood-Ridge plant of the Wright Aeronautical Corporation. Photograph courtesy the Wright Aeronautical Corp.

Cool Millions WITH THE HELP OF JONES & LAMSON *Optical Comparators*

This book "Beyond a Shadow of a Doubt" will tell you more about our Optical Comparators and what they are doing.

Proper dissipation of millions of heat units from the cylinders of the 2200 H.P. Wright Cyclone 18's that power the B-29 Superfortress, depends upon the perfection of the cylinder fins. To be sure that these fins are accurate —beyond a shadow of a doubt—the tools that cut them from solid metal are inspected on Jones & Lamson Optical Comparators.

Quality control by the inspection of tools, parts and products, with Jones & Lamson Optical Comparators, is an accurate, rapid process. Objects that require hours to inspect by other means can be inspected in minutes, or even seconds.

JONES & LAMSON
MACHINE COMPANY
Springfield, Vermont, U.S.A.

Manufacturer of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.

Unions' Usurpation of Management

(*Continued from page* 19)

the vilest trust or monopoly this country has ever seen or pictured.

To avoid this, we propose the creation of an equitable, balanced, complete and modern national labor policy. We believe there is only one way in which laws that give statutory backing to workers' basic right to collective bargaining can be saved.

We urge you to put an end to the privileged status of unions and their representatives and their exemption from basic laws and principles with which other Americans comply.

Adopt promptly a national labor policy strengthened, completed, balanced and modernized to establish a foundation for the management-labor relationship essential to the country's future if it is to fulfill its destiny.

We believe and recommend a carefully-considered policy would retain or restore to management the ability to manage; it would recognize the need to maintain the integrity and efficacy of collective bargaining and it would do so by clearly defining which employes are representing management and which represent the workers. The group responsible for management functions must be free from union control just as surely as the group responsible for union functions must be free from management control.

We believe and recommend a national labor policy should continue to protect workers from coercion on the part of the management. It should protect workers from coercion by the unions. Likewise it should protect workers, unions and management alike from governmental coercion by providing court review of administrative actions.

We believe workers', industry's and the Nation's best interests require imposition of penalties on any union which strikes before it has exhausted the grievance procedure provided in its contract and in governmental procedures. In such cases, it should forfeit the right, for a specified period of time, to governmental consideration of its demands.

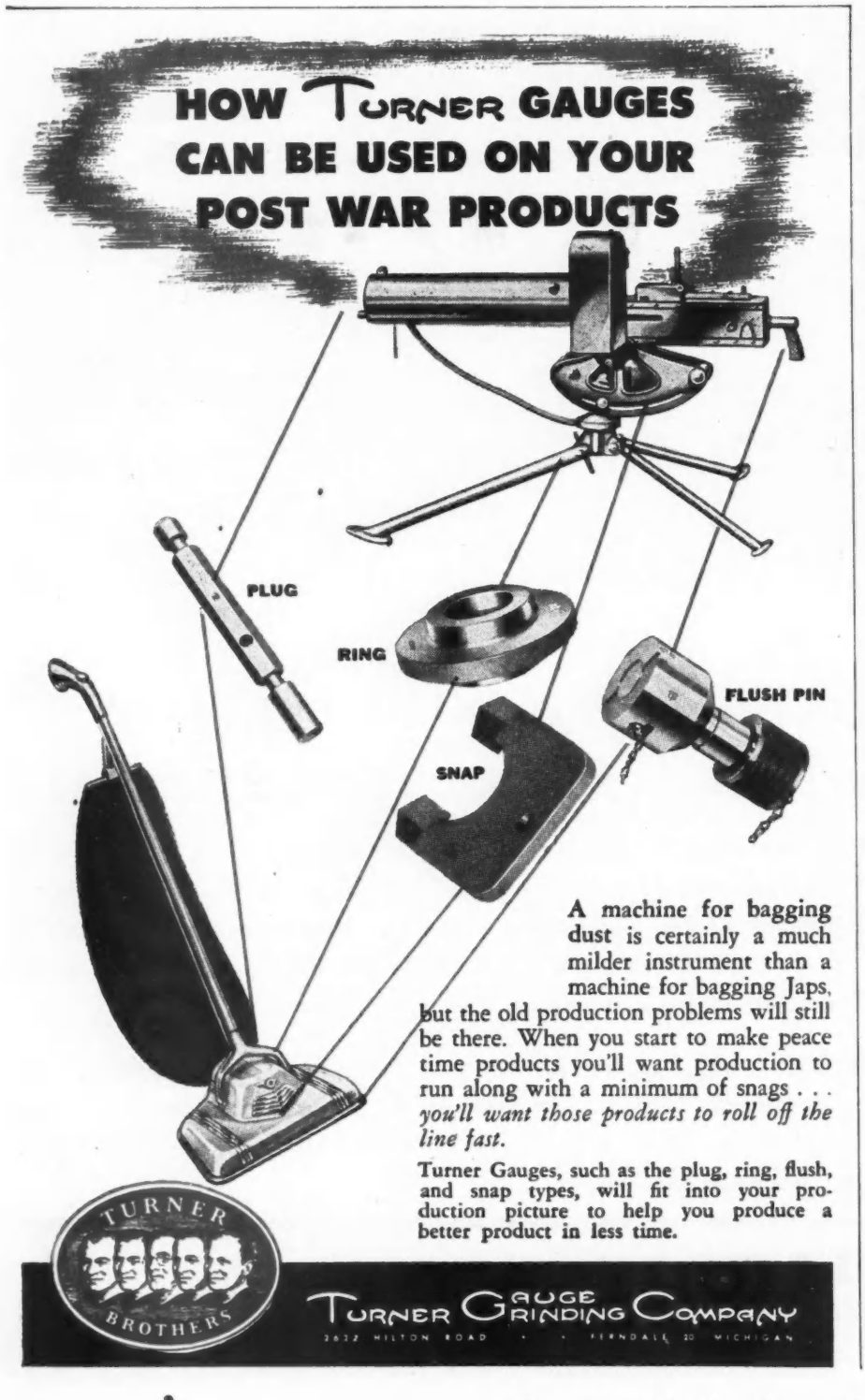
We believe and recommend a national labor policy should reverse the tendency toward centralization of administration in Washington and, instead, localize the handling of labor union-management problems.

We believe no international industrial union organization should have any more authority to direct and control the collective bargaining of unions representing employes of separate employers than the Automotive Council has to direct and control the position of its members companies. Neither an international union nor a national trade association is as well qualified to discharge the full responsibilities of collective bargaining as the particular union and employer directly concerned. Therefore, we believe the new national labor policy should lodge the responsibilities for collective bargaining in a union exclusively representing the employes of a single employer. This would permit the working out of agreements on a basis mutually satisfactory to the parties directly covered by the collective bargaining contract. This policy would make unions, which are parties to collective bargaining contracts, as responsible and as autonomous as the other party to the contract.

To further improve the equities as between workers and management, we believe the new national labor policy should give separate unions the same protection against undue concentration of power in the international unions as individual companies in the industry have in relation to their inter-industry and intra-industry trade organizations. Likewise we believe there is public agreement that the national interest requires that neither union nor management organizations should function in the political field.

We believe the national interest requires the encouragement of the incentive pay system where feasible and

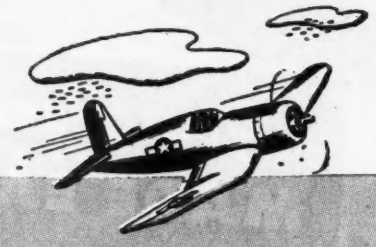
(*Turn to page* 56, *please*)


HOW TURNER GAUGES CAN BE USED ON YOUR POST WAR PRODUCTS
PLUG
RING
SNAP
FLUSH PIN
A machine for bagging dust is certainly a much milder instrument than a machine for bagging Japs, but the old production problems will still be there. When you start to make peace time products you'll want production to run along with a minimum of snags . . . you'll want those products to roll off the line fast.
Turner Gauges, such as the plug, ring, flush, and snap types, will fit into your production picture to help you produce a better product in less time.
TURNER BROTHERS
TURNER GAUGE GRINDING COMPANY
2632 HILTON ROAD FERNDALE 20 MICHIGAN

Buy War Bonds

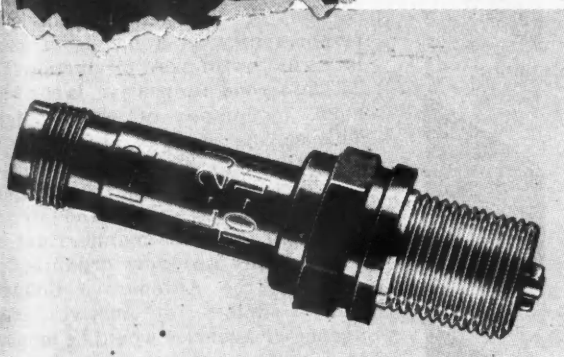
Auto-Lite

ELECTRICAL EQUIPMENT FOR AIRCRAFT

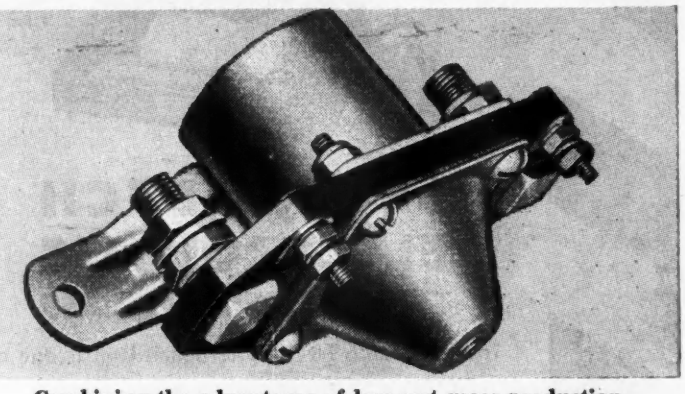


For years, one of the world's largest manufacturers of electrical equipment, Auto-Lite's 22 plants are today producing large quantities of fine electrical equipment for aircraft. Pictured here are some examples of these precision-built products.

THE ELECTRIC AUTO-LITE COMPANY
SARNIA, ONTARIO TOLEDO, 1, OHIO

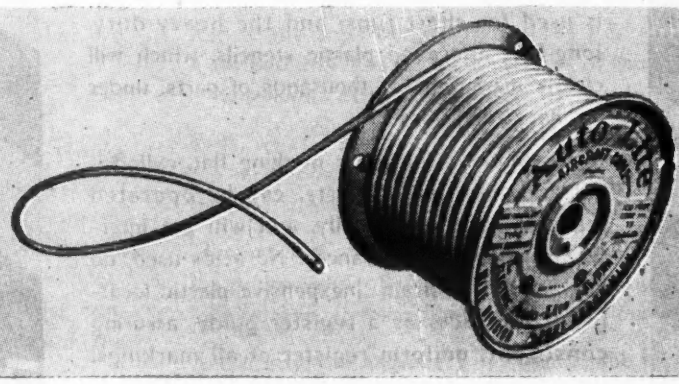


Outstanding features of these great spark plugs are (1) Direct contact non-inductive resistor located in coolest position in plug; (2) Deep drawn nickel alloy center electrode tip; (3) Improved copper cooled center electrode; (4) High Dielectric strength and superior mechanical properties of "Corundum," Auto-Lite's insulator material.



Combining the advantages of low-cost mass production and precision manufacturing, Auto-Lite relays are available for both continuous and intermittent duty. They are built to exceed the most exacting government requirements, achieving outstanding records in vibration, acceleration and altitude tests. Both types are operative from minus 60 deg. F. to 160 deg. F.

Auto-Lite batteries, noted for their brilliant performance records, are available in both 12 volt and 24 volt types. All are equipped with special non-spill vent plugs and assembled in either hard rubber or radio-shielded aluminum containers. The heavy duty battery has a capacity of 105 A.H. at 5 hr. rate; others have capacity of 34 A.H. at the 5 hr. rate.



Auto-Lite Steelductor Aircraft Ignition Cable is used as standard equipment in aircraft engines where wires are carried or held in place with metal guides or conduits. Some of its noteworthy features when in a shielded circuit, are: Longer cable life, increased life of spark plug electrodes and higher peak secondary voltages with the same primary coil current.

AUTO-LITE

TUNE IN "EVERYTHING FOR THE BOYS" STARRING DICK HAYMES—EVERY TUESDAY NIGHT—NBC NETWORK

Your Parts Marking
MADE EASY, FAST,
Economical and Legible

LECTROETCH ELECTROLYTIC
STENCIL ETCHING PROCESS

The Lectroetch Electrolytic Bench Unit is one of the most popular parts marking units on the market due to its speed in marking, (a matter of seconds), its absolute legibility, and the ease in which it can be handled.

There are two kinds of stencils used, the embossed, which can be made on a typewriter and is used for short runs; and the heavy-duty, long-life, engraved plastic stencils, which will clearly mark tens of thousands of parts, under ordinary conditions.

Bench Model is ideal for marking flat, cylindrical and odd-shaped parts, can be operated manually, or automatically, and will not interfere with surface tolerances. No acids used, no heat, shock, or strain. Inexpensive plastic locating fixture acts as a register guide, assuring consistent, uniform register of all markings.

Send for more detailed information.

The LECTROETCH *Company*
1727 DOAN AVENUE • • CLEVELAND 12, OHIO

particularly where it would increas war production. The record in our i dustry indisputably shows that pro erly designed incentive wage systems increase wages and productivity.

We believe the national policy shou require that the unions themselves sha pay union stewards or committeeme or other union officials for the tim spent on union business.

The Alternatives

What are the alternatives? Ther are only three possible courses union management relations can take.

First, a continuation of management union disagreements as to the manage ment of the plants, which would mea more strikes and stoppages and a fur ther wartime lowering of productivity Automotive company management have put up with the unbelievable in terferences and made temporary con cessions of management functions an responsibility as a means of avoidin interruption of war production.

The second alternative, is the achieve ment by unions of their objectives This can be accomplished in two ways One, through the intermediate step o industry-wide collective bargaining making it necessary for industry to or ganize in the same manner that indus trial unions are now organized. For example, the Automotive Council, o some similar automotive industry agency or agencies would be empowered to negotiate the wages, hours and working conditions of all its 525 mem bers and scores of non-members and agreements made by such an agency would be binding on General Motors, Packard, Borg-Warner, the Anderson Co., the other automotive companies large and small, peacetime products of which in many instances are largely unrelated.

It is clear that industry-wide collective bargaining is a major step toward the corporate state and cartelization of American industry. Through the back door of existing industrial unionism, we shall have created industry-wide monopolies and fixation of prices and production. The competitive principle and practice in this country will have been destroyed and consumer prices will rise.

The third alternative is to strengthen the collective bargaining function of unions by modernizing our national labor policy along the lines previously suggested. With separate industrial unions bargaining with separate employers, both fully responsible for their acts, the management-labor relationship that must exist if we are to obtain improved productivity during the war and a higher standard of living following the war can come into full force and effect. How can this cooperative management-labor relationship, at the employer and plant level, best develop? Can it develop permanently as long as management is dealing not with the present powerless representatives of its

(*Turn to page* 58, *please*)

THE 6TH AVENUE "EL" WAS **NOT** SENT TO PEARL HARBOR!

In the January 22nd issue of TIME Magazine, we ran this illustration with a headline reading: "Remember when we sent the 6th Avenue 'El' to Pearl Harbor?"

This was a mistake.

The 6th Avenue "El" was *not* sent to Pearl Harbor — thanks to the straight thinking and vision of Mayor F. H. LaGuardia, Stanley M. Isaacs, Manhattan's Borough President, the support of the other members of the Board of Estimate of the City, and the strict adherence of the Harris Structural Steel Company, contractors for this work. The contracts for the demolition of the "El" stipulated that the scrap iron would not be sold or exported directly or indirectly to any foreign country with the exception of Great Britain. Not one pound of this scrap ever left the United States.

And that was three years before Pearl Harbor — back in the "appeasement" days!

It's too bad there weren't more men thinking straight in those days. Because more than 6 million tons of scrap was sold to the Japs during those three years. And many an American boy was hit by fragments of that American steel — fragments of our own weak thinking in the past.

Well, we're strong now. America will come out of this war the most powerful force on earth, and the time to start *thinking* strong is now.

Our greatest immediate contribution to American strength in the future—strength here at home—must be the provision of jobs for our returning fighting men; jobs and security for all!

And today, the engineers of the machine tool industry can greatly help the men of government and of industry to provide those jobs . . . to plan now for the reconversion of our tremendous resources in materials and plant equipment to all-out production for a better America! One of these engineers *is a* Bryant man. We urge you to call him now.

BRYANT CHUCKING GRINDER COMPANY SPRINGFIELD VERMONT, U.S.A.

Chace Alloy No. 772 provides a unique combination of properties useful to electrical equipment, control and instrument manufacturers.

Its electrical resistivity is about 60% higher than most resistance alloys in common use . . . 1050 ohms per circular mil foot.

Its thermal conductivity is less than 50% that of steel . . . only about 2% that of copper.

Its temperature coefficient of expansion is twice as great as ordinary steel . . . much higher than that of any other strong alloy.

Neither its resistivity value nor its expansion rate is affected by thermal treatment . . . or by cooling to —100° F.

Chace Alloy No. 772 is non-magnetic.

This new engineering material is especially adapted to low temperature resistor applications, rheostats, auxilary heater for circuit breakers, and other electrically heated expansion elements . . . Available now in sheets, strips, and rods.

"Bulletin No. A-942", giving detailed information regarding Chace Manganese Alloy No. 772, sent on request.

W.M. CHACE CO.
Manufacturers of
Thermostatic Bimetals and Special Alloys
1610 BEARD AVE • DETROIT 9, MICH.

own workers but with officials of industry-wide or international unions? How can it develop when the officials of these international unions are rapidly increasing their ability to bring the full political and economic power of six million workers to bear on a single employer of a handful, a few thousand, or a hundred thousand workers? Consider the full implication of the economic boycott, or the CIO Political Action Committee.

Great accomplishments require good organization. Good organization requires order and discipline. Order and discipline depend upon clearly understood and accepted functions, authority and responsibility. The functons, authority and responsibility of management have been diluted and confused. Continued and further division of the management responsibility will increase the magnitude of our wartime and postwar national problems.

Post-War Employment

(*Continued from page* 15)

or about 30 per cent are in the branch of manufacturing designated as "Auto, Aircraft and Parts." It can be said of this, even if the figures are not questioned, that the phraseology is not sufficiently descriptive and the terminology is not good. Moreover, it is important to remember that it will be much more than 30 days before this large group, or what is probably a considerably large number of workers, can be fully absorbed.

The figures deal only with manufacturing. The extent of unemployment during reconversion or, more particularly, the measure of opportunity for employment in the automotive industry and its allied lines when that industry gets back into its stride, is only partially expressed by them. It might well be said again, therefore, that, in the national interest, definite pre-reconversion plans, at least, for the automotive industry on an industry wide basis should, at the earliest possible moment, be formulated and made ready for execution.

Ira Mosher, president of N.A.M., goes much further than that and takes in a lot more territory in a statement which was issued shortly after the words above were written. Says Mr. Mosher:

"If industry, which has been responsible for its share of the jobs heretofore in this country, and which has been a prime mover of prosperity, is not allowed to prepare for V-E day and for eventual peace, the penalty of unpreparedness, which is failure, will be paid not only by industry, but by society as a whole. To say that we may not think or talk of reconversion now is to sentence us to a peacetime default in our responsibilities which might put the whole economic system in the hands of government. Such a sentence would disestablish us in advance. Therefore, let us get busy on our preparations for reconversion."

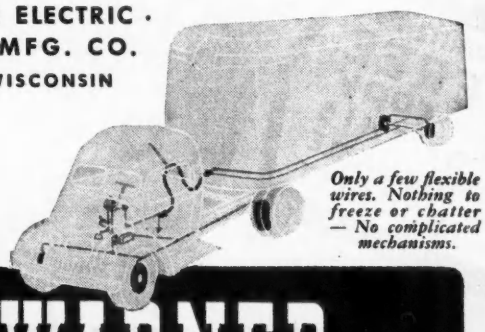
THERE MUST BE NO COMPROMISE WITH *Safety*

TODAY, America is depending on motor transportation as never before. Every load of war materials and equipment carried by big trailer outfits must get through — and *on time!* Delays due to accidents caused by ineffective brakes must be prevented — there should be no compromise with *safety!*

It is significant that 80% of all power-brake equipped trailing vehicles purchased by the government during this war — *have Warner Electric Brakes.* So take a tip from Uncle Sam — protect your drivers, your cargoes, and your trailer outfits — give them the EXTRA SAFETY of *Controlled Braking Power* — exclusive feature of Warner "Vari-Load" ELECTRIC Brakes. No matter what the weather, the driver can pre-set any and all brakes to fit BOTH load conditions and road conditions — thus keeping his train straightened out and under full control even when the going is slippery, and avoiding costly tie-ups due to damaged equipment.

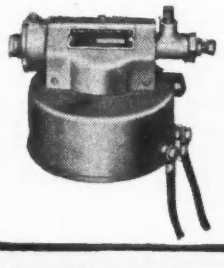
On all future trailer purchases, specify Warner "Vari-Load" *Electric* Brakes — world-famous for safety, simplicity, and dependable, efficient, trouble-free performance.

WARNER ELECTRIC · BRAKE MFG. CO.
BELOIT, WISCONSIN



Only a few flexible wires. Nothing to freeze or chatter — No complicated mechanisms.

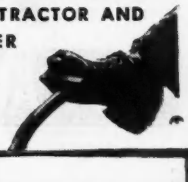
WARNER
ELECTRIC BRAKES



NOW — Present Owners of Trailers with Warner Electric Brakes Can Have This New WARNER CONTROLLER

The new Warner Controller — simple and compact — synchronizes the hydraulic brakes on tractor with the Electric Brakes on trailer. The tractor's regular foot pedal operates both braking systems. This development creates smooth foot-touch tractor-trailer breaking under all conditions—eases driving strain—assures greater safety. Controller is easily and quickly fitted into hydraulic brake line. See your Warner dealer about changing over your present equipment.

FOOT PEDAL PRESSURE CONTROLS BRAKES ON BOTH TRACTOR AND TRAILER



New Products

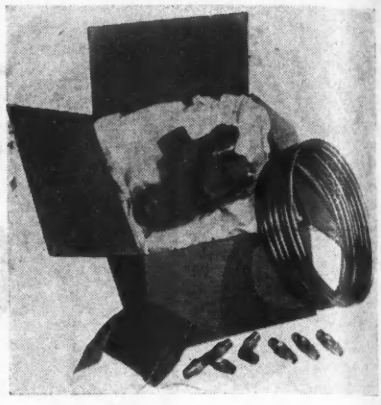
(*Continued from page* 40)

a less number of component parts, production has been increased by approximately 10 per cent.

Tires made of this construction are more easily repairable, and the stronger rayon plies offer greater resistance to rupture growth—a factor which heretofore placed injured truck tires beyond the possibility of repair. Furthermore, the new tires will take recapping better and oftener.

Valve Removes Moisture from Air Brake System

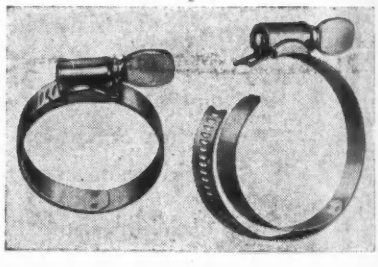
Latest product of the Bendix-Westinghouse Automotive Air Brake Co., Elyria, Ohio, is a new automatic valve, known as the Rezordrain, which removes water and other foreign matter from air brakes or pneumatic door controls in bus service. The valve is synchronized with the air brake or door control and functions automatically. The Rezordrain not only removes foreign matter from the braking or door control system but, due to its automatic action, actually prevents its accumulation.



Bendix-Westinghouse Rezordrain

Improved Worm Drive Hose Clamp

Wittek Manufacturing Co., Chicago, Ill., has brought out an improved worm drive hose clamp, the Wittek Type WWD. It is made to specification AN-FF-C-406A and incorporates a new exclusive feature—an inner band of stainless steel which protects the hose from the serrations in the outer band and distributes the load uniformly to provide greater strength and sealing characteristics. The new hose clamp is made of stainless steel, and has a compact streamlined housing and hardened one-piece thumbscrew. Eight adjustable sizes are available to cover the entire range of applications.



Blind Plastic Grommet

For insulation and protection of cables and lines passing through bulkheads of ships and aircraft, and for many applications of electrical insulation, the non-inflammable plastic blind "Des-Grommet" produced by the Victory Mfg. Co., So. Pasadena, Cal., is said to offer many advantages.

The "Des-Grommet" is composed of two parts, molded from a non-inflammable formula of Lumarith, prepared especially for Victory Mfg. Co. by the Celanese Corp. The two parts are so designed that they may be applied from

(*Turn to page* 64, *please*)

FRICTION SAWING
SHEET STEEL Formed or Flat
NON-FERROUS METALS Formed or Flat
ARMOR PLATE
SOFT or HARDENED STEELS
PLASTICS
GLASS and Other Materials
By Arthur A. Schwartz
Chief Tool Research Engineer
Bell Aircraft Corporation
WRITE FOR FREE COPY OF THIS VALUABLE BOOKLET
Sensationally Fast, Safe and Widely Applicable..
this method is rapidly displacing other cutting methods. Learn all about it and the machines that make it possible —
Tannewitz
HIGH SPEED BAND SAWS
THE TANNEWITZ WORKS
GRAND RAPIDS 4, MICHIGAN

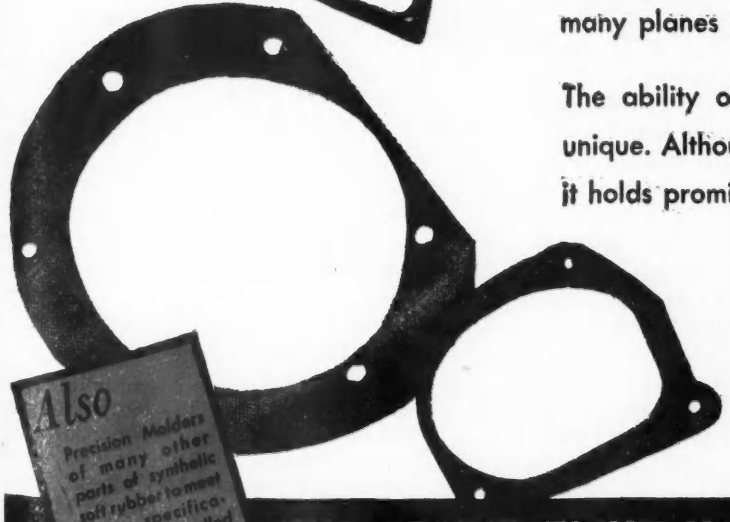
COHRE Conductive GASKETS

Improved Radio Reception

THIS ingenious pressure sealing gasket (patent applied for) grounds high frequency currents built up in various metallic parts. By dissipating the static, radio reception in many planes is decidedly improved. .

The ability of this gasket to both conduct and seal is unique. Although developed for this specific war time use, it holds promise for many peace time applications.

IF you have a problem involving the dispersal of high frequency or static electricity through a pressure sealing gasket, one of our engineers will be glad to call and discuss it with you.



Also
Precision Molders of many other parts of synthetic soft rubber to meet close specifications now called for by the Air Corps

THE CONNECTICUT HARD RUBBER CO.

423 EAST STREET, NEW HAVEN, CONN.

Custom Rubber Molders Since 1920

for Production Measurement of Shell Surfaces

PRCo announces its Type CP Roughness Meter for the roughness measurement of the surfaces of high-explosive shells. The Roughness Meter enables the control of the surface roughness of shells on a practical production basis in much the same manner as the Profilometer for checking surface roughness of precision machine parts.

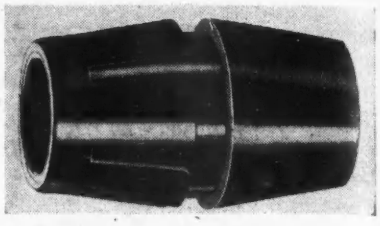
In appearance and operation, the Roughness Meter greatly resembles the Profilometer except that it enables the measurement of surface irregularities so widely spaced as to be beyond the range of the Profilometer, now generally used on smoother surfaces. The Roughness Meter employs a hand-operated Tracer which traces the surface of the shell, and gives a reading on the meter directly in terms of microinches of average roughness.

To withstand the heavy use of the equipment on shell inspection lines and on the extremely coarse surface found on shells, the Tracer used with this unit is heavy and rugged and uses a blunter, stronger tracing point than that with the Profilometer. The Tracer can be used by hand to measure from the tip of the ogive to the boattail, the Tracer point being self-adjusting to changes of curvature of from 1½" OD to flat.

Because of the importance of surface roughness in the performance of shells and, therefore, in the efficiency and accuracy of our artillery, Physicists Research Company is making every effort to give prompt delivery for this equipment. If your plant is faced with the problem of controlling the surface roughness of high-explosive shells, we will be pleased to have our representative call and discuss the matter in more detail with you. Complete information on the Type CP Roughness Meter will be gladly supplied on request.

Physicists Research Company

343 SOUTH MAIN STREET . ANN ARBOR . MICHIGAN



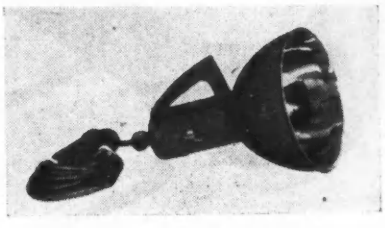
Des-Grommet made of Lumarith

one side only by means of a special tool. To install the "Des-Grommet," it is slipped onto the special tool and thrust through a hole in the partition. As the grommet is drawn together, an under-cut section on one half is engaged with a spring locking section on the other. The tool then forces the two sections together, locking them into one integral unit at the point at which the partition stops further movement.

The "Des-Grommets" are furnished in a wide range of sizes to accommodate cables and tubes from ¼ in. through 2 in. in diameter. Two sizes for wall thicknesses are supplied, one to accommodate ⅛ in. to ½ in. and the second for bulkheads ½ in. to 1 in. in thickness.

Portable Infrared Unit

The Fostoria Pressed Steel Corp., Fostoria, Ohio, offers a new line of portable infrared units in three models. The various models may be used for applications such as baking, drying, preheating, etc. A 20-gage black metal



Fostoria Model 60-000 heating unit

panel 1½ in. in diameter can be heated in excess of 800 F in 1½ minutes with any of the models when the edge of the reflector is spaced 2½ in. from the metal. The Model 60-100 is equipped with a crow-foot base and an adjustable arm. A clamp base is provided on the Model 60-200 for mounting on wood or metal framework.

Fansteel Develops New Hard-Facing Material

A new non-ferrous hard-facing metal has been placed on the market by the Fansteel Metallurgical Corporation, North Chicago, Ill., under the name Fanweld. The metal is intended for acetylene torch application to steel, and is said to possess marked resistance to abrasion, heat, impact and erosion.

Fanweld contains tantalum-columbium carbide which imparts a peculiar self-lubricating action, minimizing the destructive effects of friction even at

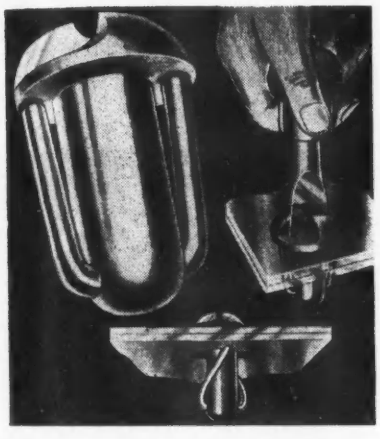
(*Turn to page 67, please*)

elevated temperatures. Extensive tests in the Fansteel plant indicate that Fanweld is unusually well suited for hot work punches, dies and tools.

Properly applied, Fanweld "wets" steel surfaces readily without the use of flux, flowing smoothly and evenly. Surfaces as thin as .010 in. can be applied with a fusion layer as thin as .0005 in. No hardening or heat treating operations are necessary. Fanweld is made in 3/16 in. and ¼ in. diameter rods in 14 in. lengths.

One-Piece Spring Lock Fastener

A one-piece fastener assembly, which does not require nuts or receptacles, has been added to the line of the Simmons Machine Tool Corp., Albany, N. Y. The



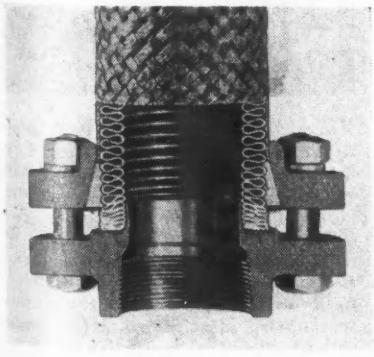
Simmons Spring Lock fastener

fastener is self-adjusting to compensate for various material thicknesses within its range. The construction of the head assures one-direction rotation for locking or unlocking. A quarter turn puts the initial twist in the spring and another quarter turn locks the fastener in place.

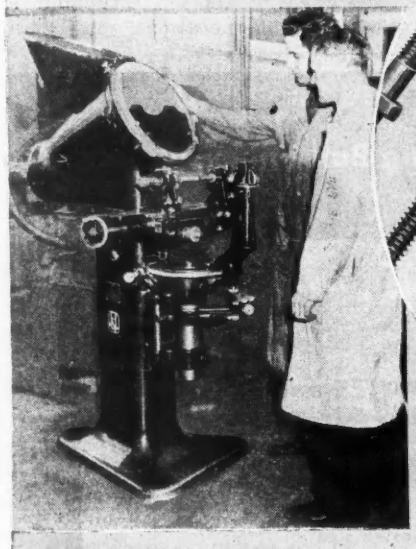
Detachable Flange for Flexible Metal Hose

A new detachable flange for helical flexible metal hose, in sizes 2, 2½ and 3 in. I. D., has been developed by Packless Metal Products Corporation, New Rochelle, N. Y. It is so designed as to permit repeated re-use. No brazing is

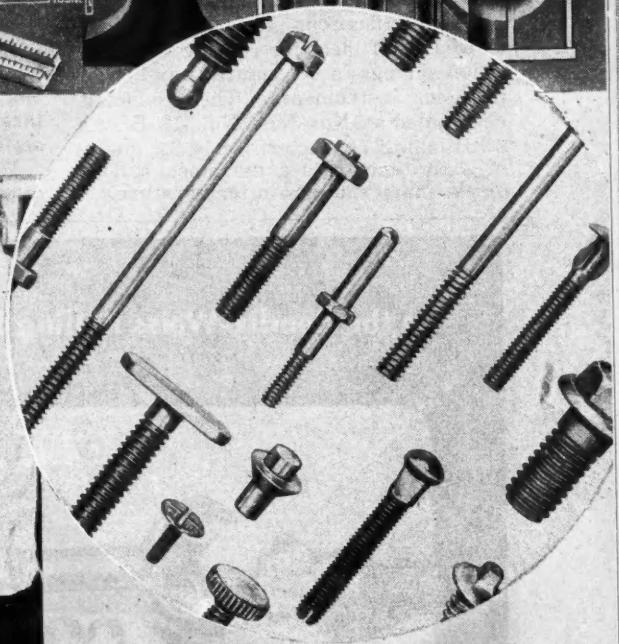
(*Turn to page* 68, *please*)



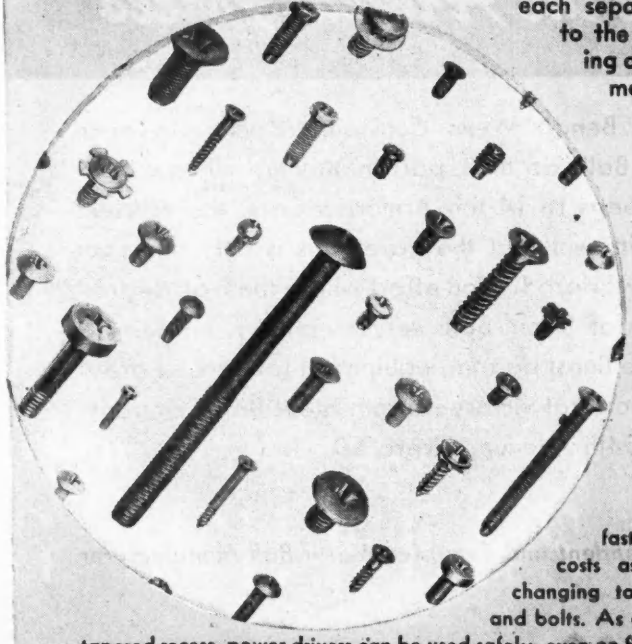
Packless hose flange



Modern comparators supplement micrometers, gages and other inspection devices to insure uniform precision of HOLTITE Engineered fastenings throughout production.



"Engineered Fastenings" is not a catchphrase! It is a brief, obvious designation of the scientific production of HOLTITE screws, bolts and allied fastenings. A technical engineering staff directly supervises every operation, from the analysis of raw material, through our own steel processing mill and wire drawing departments, through each separate stage of manufacture to the final hardening, heat-treating and finishing operations. With modern chemical and metallurgical laboratories and special testing equipment, our engineers have every scientific aid to control the precision production of standard and Special HOLTITE fastenings.



Cut your fastening time and costs as much as 50% by changing to HOLTITE-Phillips screws and bolts. As driver or bit does not slip from tapered recess, power drivers can be used safely, even on finished parts, to speed production and lower costs. Screws set up tighter to resist vibration and strengthen assembly. Specify HOLTITE-Phillips on next order.

BUY MORE WAR BONDS

CONTINENTAL SCREW CO. New Bedford, Mass., U.S.A.

required. No gasket is employed to connect the flange to the hose, thus making a metal-to-metal seal.

Combined Lubricant and Rust Preventive

Nox-Rust Corporation, Chicago, Ill., has devised a combined rust preventive and lubricant which meets Army and Navy specifications. It is said to have proved itself ideal for coating fine, precision springs in aeronautical and other precision instruments. The product is designated as Nox-Rust No. 318 E. An outstanding characteristic is its immunity to temperature extremes and to quick, sharp changes in temperature.

Machine Dry-Cleans Strip-Wood Floors

For dry-cleaning of strip-wood floors in one operation, the G. H. Tennant Company, Minneapolis, Minn., has placed on the market a heavy-duty floor machine. Fitted with a special 16-in. factory-wound steel wool roll, the Tennant machine burnishes dirt from the floor. Through a vacuum system, powered by an 11-in. fan, light soilage is drawn into a large heavy-fabric bag. Heavy soilage is thrown into a large removable hopper by centrifugal action of the steel wool roll.

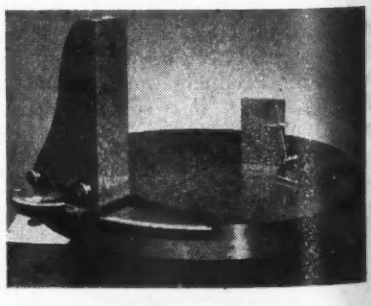
Designed to replace scrubbing and other manual operations, dry-cleaning with this machine is said to be required only one-sixth as often as scrubbing.

Tennant floor cleaning machine

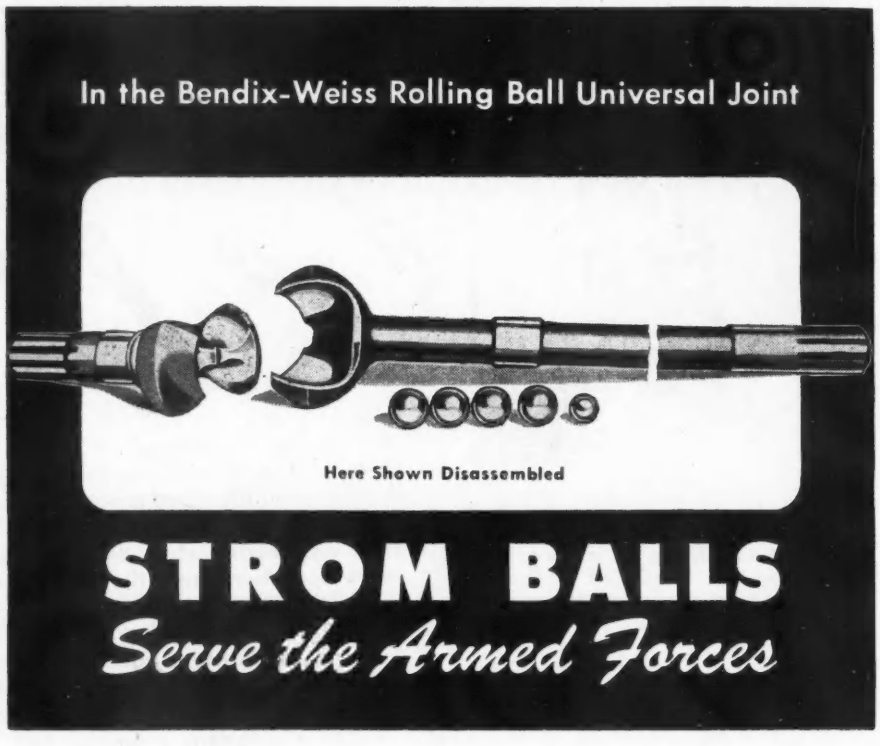
Double Coil Spring Lock Washers

Developed by the George K. Garrett Co., Philadelphia, Pa., these double coil spring lock washers are said to have great reactive spring pressure, plus high resistance to shock, vibration and severe service. They are furnished in sizes for No. 4 screws up to 1-in. and larger bolts. Both standard and heavy types are available.

Steel Layout Plates



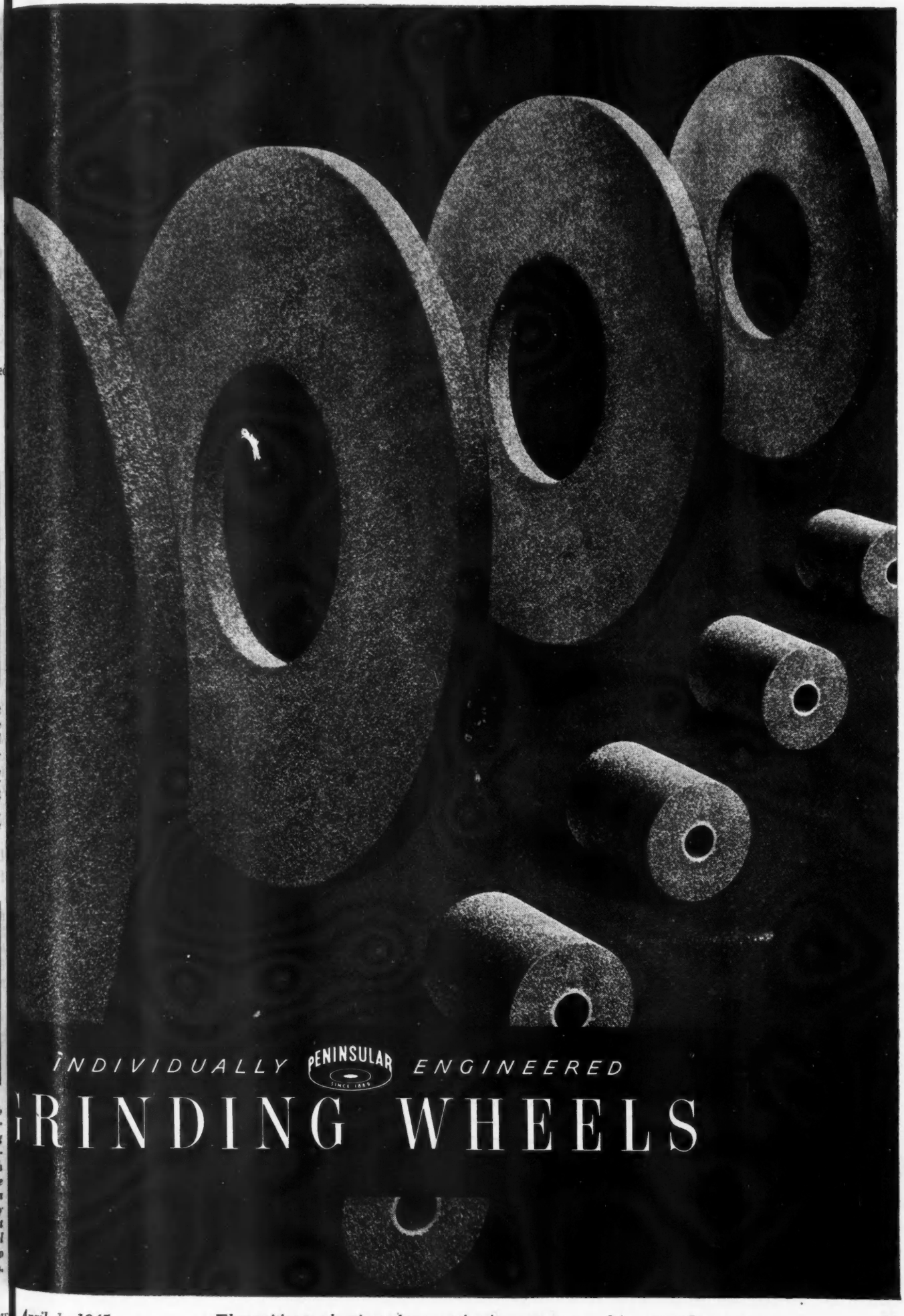
This MLM radial layout plate, made by the Contour Co., Pasadena, Cal., provides a flat working surface in any of the three dimensions. These surfaces intersect each other at 90 deg. Through the use of specially designed protractors, a flat vertical surface is automatically held on the radius line throughout the entire 360 deg. MLM radial layout plates are furnished in two regular sizes, 24 in. and 96 in. Other sizes are custom built.



Here, in the Bendix-Weiss Constant Velocity Universal Joint, Strom Balls do their part in making military vehicles, from Jeeps to 14-ton Armored Cars, the efficient fighting equipment that they are. This is only one spot in our great war production effort where the high degree of perfection of Strom Balls serves industry, enabling it to provide the finest bearing equipment towards its great contribution to total victory. Strom Steel Ball Company, 1850 South 54th Avenue, Cicero 50, Ill.

Largest Independent and Exclusive Metal Ball Manufacturer

Strom BALLS Serve Industry


INDIVIDUALLY PENINSULAR ENGINEERED
GRINDING WHEELS

OUT OUR WAY

HEY, THERE! WHAT'S-
HE STARTED UP THERE WITH A TERRIBLE ROAR TO BAWL THAT GUY OUT FER SLEEPIN'-- NOW HE SEES TH' BROOM AND REMEMBERS JOE DOESN'T HAVE MUCH TO DO SINCE WE GOT SPEEDI-DRI!
THAT'S TH' BIRTH OF A NEW MACHINE OPERATOR RIGHT THERE! TH' BOSS BROUGHT IN SPEEDI-DRI TO STOP SLIPS AND FALLS-- NOW HE'S DISCOVERED IT'S A LABOR SAVER!
T. M. REG. U. S. PAT. OFF. COPR. 1945 BY NEA SERVICE, INC.
THE UPPER CRUST
J.R.WILLIAMS

ONE PLANT took 14 men off floor-cleaning and put them on more valuable work, after discovering SPEEDI-DRI. This new floor-cleaning material is easy to use. It soaks up oil and grease, cuts down on slips and falls. Simply spread a layer of SPEEDI-DRI wherever there's oil or grease, and it furnishes a non-skid, safe footing. After all oil has been absorbed, just sweep up the SPEEDI-DRI with an ordinary, stiff broom. Any shop porter can do this work. No trained crews of cleaners are needed. No complicated, expensive cleaning machines. No dangerous caustics or solvents.

SPEEDI-DRI works well on all types of floor: wood, concrete, or composition. It's inexpensive to use, eliminates the danger of fast-spreading fires, and is recommended by leading insurance companies.

Write today for a big, free sample. SPEEDI-DRI for ordinary oils and greases. SOL-SPEEDI-DRI for soluble oils, resins, acids, solvents, coolants, and syrups.

SUPPLIERS: East—Refiners Lubricating Co., New York 1, New York.
Midwest & South—Waverly Petroleum Products Co., Philadelphia 6, Pa.
West Coast—Waverly Petroleum Products Co., Russ Bldg., San Francisco 4, Calif.

SPEEDI-DRI
OIL AND GREASE ABSORBENT

UL

"Think First—Stop Accidents"

British Air Liners

(*Continued from page* 22)

and priority mail or freight over long distances at high speed and regardless of cost. Hence, instead of the Lancaster bomb load of 14,000 lb, the maximum payload is officially put at only 4845 lb for gross weight of 65,000 lb, though there is said to be no reason why a maximum of 72,000 lb should not be allowed.

There is accommodation for only nine passengers, all of them seated with their backs to the port wall of the cabin, facing windows on the starboard side. There are lavatory arrangements, steward's galley and three baggage or mail compartments, one of these in the nose of the fuselage displacing the bomb-aimer's compartment. Data regarding performance, weights and dimensions, issued by the Ministry of Aircraft Production, are given in the accompanying table. In this it will be seen that the maximum speed with full supercharge at 12,000 ft is 310 mph and with medium supercharge 295 mph at 3500 ft; in test flights it is said to have attained 295 mph at 18,500 ft.

By the time these words are in print, Lancastrians of the latest type will be in service on the western half of the Britain-Australia route, operated by British Oversea Airways Corp. Earlier models, it may be recalled, have been operated for some while past in Canada and on a thrice-weekly service across the North Atlantic.

Avro York and Tudor

A condition of the specification of the four-engined Avro York—which already is in service—was that the machine should be completely convertible from passenger aircraft to freighter, and vice versa, within 24 hours. Although it has the same wing, tailplane, and dual fins and rudders as those used for the Lancaster bomber (and a third, central fin), the fuselage is entirely different and it has a high wing and tail instead of the mid-wing of the bomber. Moreover, it is longer and has approximately double the cubic capacity. The maximum payload is 23,500 lb for a range of 500 miles, diminishing progressively to 9250 lb for a range of 3000 miles. Maximum speed is in excess of 300 mph, maximum cruising speed 275 mph and maximum cruising speed for fuel economy 220 mph. Either the Rolls Royce Merlin or the Bristol Hercules 14-cylinder sleeve valve radial engine can be fitted. Passenger accommodation varies from 24 to 32 according to the luxuriousness of the furnishings.

The following Avro York specifications have been announced: Gross take-off weight—65,000 lb; Weight empty—33,200 lb; Structure weight—19,483 lb; Wing span—102 ft; Wing area—1205 sq. ft; Length—78 ft; Heights—20 ft; Take-off wing loading 53.9 psf; Take-

(*Turn to page* 74, *please*)

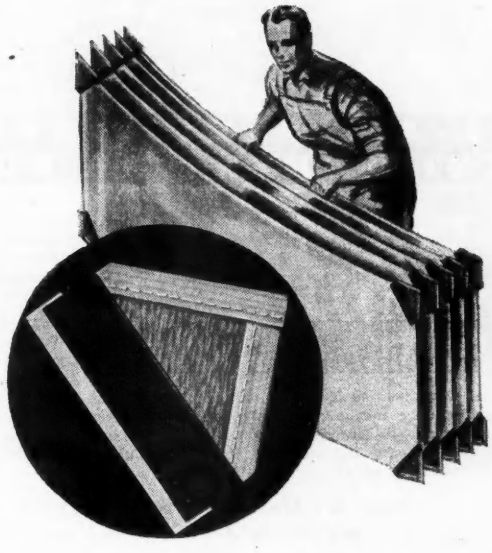
A CORNER ON ALUMINUM

. . . and How It's Protected!

A serious toll of both money and time was being taken by damage to square ends and corners of airplane sheet aluminum stocks, in a California aircraft plant.

So, Bauer & Black technicians co-operated with a paper converting company in the territory, and the device illustrated here was the result. It's a tough paper guard, or protective cover (patented) formed to shield those corners.

It slips on easily and quickly, and a Bauer & Black Industrial Tape holds it firmly in place. Today, it's a "must" with major West Coast aircraft producers. Simple? Yes. But it took experienced research, knowledge and ingenuity.



RESEARCH MAY UNCOVER TAPE SAVINGS FOR YOU

No matter how good the Industrial Tape, only research and often laboratory testing can determine whether you are getting maximum benefits from its use. By the same token, research may *uncover* many places where you can use Industrial Tape to solve operational problems, and effect savings in time and money.

Why not prove it for yourself? You are under no obligations of any kind when you ask for the co-operation of Bauer & Black technicians.

BAUER & BLACK

Industrial Tape

PRESSURE SENSITIVE ADHESIVE

WRITE TO DEPT. 34 and tell us when our trained sales engineers may call on you. It costs you nothing; they may help you to save money and increase plant efficiency.

A product of

BAUER & BLACK

Division of The Kendall Company

2500 SOUTH DEARBORN ST., CHICAGO 16, ILLINOIS

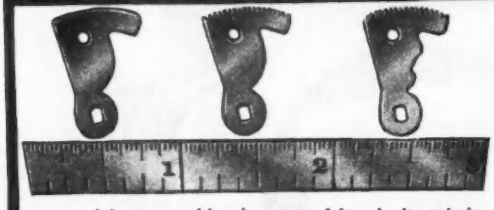
RESEARCH TO SPEED AND IMPROVE METHODS . . . PRODUCTION SHORT CUTS TO REDUCE COSTS

★ ★ ★

Tel-air

"MEANS ACCURACY"

TEL-AIR PARTS COUNT IN THE ACHIEVEMENT OF VICTORY . . .



Another Tel-Air Part. Small segment showing three operations—blanking, cutting the teeth, and forming. Note comparative size.

•

Even such tiny segment gears as the one illustrated here must be unfailingly accurate in operation if some essential war machine is not to falter in its mission of destroying the enemy. Tel-air accuracy means absolutely uniform precision, tolerance and concentricity in every machining and finishing operation. It is this kind of precision engineering and workmanship which we are putting into intricate bomb fuses and hundreds of vital component parts for the war effort.

Now! We Are Not Interested in our Post-War Products.
We Are Only Interested in Winning the War.

In the Air it's Tel-air

The TELEOPTIC Company
1257 MOUND AVENUE • RACINE, WISCONSIN

On the Highway it's Teleoptic

C-F POSITIONERS

6 Sizes, Capacities to 30,000 lbs.
Manual or Push Button Control

The extra strength built into C-F Positioners enables them to withstand the extreme side thrusts and torsional strains met in positioning cumbersome or unbalanced loads—Coupled with the C-F *pedestal mounting* and adjustable height features, this extra strength increases the range of work handled, makes each C-F Positioner the most versatile tool in its capacity. You can do more work with C-F Positioners.

Write for Bulletin WP-22

CULLEN-FRIESTEDT CO.
1322 S. Kilbourn Avenue Chicago 23, U.S.A.

off power loading — 12.89 lb. per hp.

Little can be said about the Avro Tudor at present. It is expected to be in the air some time this year. Essentially a commercial aircraft designed to fulfill postwar requirements, one version, Tudor I, the trans-Atlantic type, will have accommodation for 125 passengers with a gross weight of 76,000 lb and an economical cruising speed of 250 mph. The other version, Tudor II, will be a 68-passenger, pressurized cabin machine for "stage" flights up to 2000 miles.

For feeder line and air taxi services A. V. Roe will produce a civil version of the Avro Anson reconnaissance-bomber. With two 375 hp Cheetah XV engines, it will carry six passengers and a crew of two. The gross weight will be 9500 lb, the cruising speed 150 mph and the still air range 400-500 miles on a fuel tankage of 140 Imp. gal.

De Havilland-Airspeed

Another new air liner, at present unnamed, is nearing completion in prototype form. It is a 40-passenger machine designed for feeder-line duty and is being built by the Airspeed Co., a subsidiary of the de Havilland Co., makers of the famous all-wood Mosquito fighter-bomber.

The de Havilland Co. also has in the preliminary stages a small low-wing all-metal monoplane with two engines of the Gipsy-Six series. This machine is intended for operation in any part of the world, carrying up to 8 passengers or the equivalent in freight. It will rate as a replacement machine for the de Havilland Rapids, a twin-engined all-wood biplane, though the latter will remain in production as a type suitable for small air lines and in air services where there is lacking the facilities essential to the operation and maintenance of aircraft with supercharged engines, variable pitch propellers, retractable undercarriage and intricate electric or hydraulic installations.

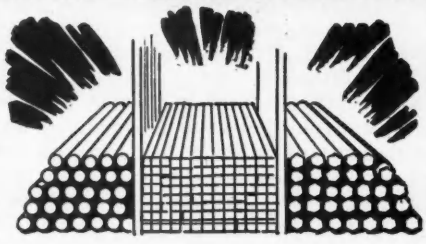
Vickers-Armstrong V.C.I.

The aircraft section of Vickers-Armstrong has announced recently that in the immediate postwar period it will be able to offer a new 27-passenger air liner, to be known as the V.C.I., the primary objective being an aircraft of low initial cost that can be put into quantity production as quickly as possible. Use is being made, therefore, of a considerable number of aircraft components already in production by Vickers-Armstrong. Three prototypes to the order of the Ministry of Aircraft Production are said to be well advanced.

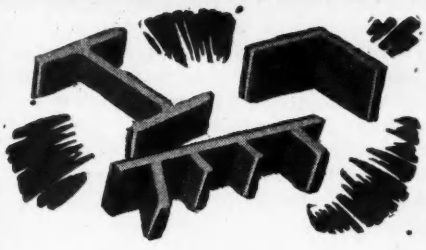
The V.C.I. will be of stressed skin construction throughout and will include the following features: Two Bristol Hercules engines; span 89 ft 3 in.; height 6 ft 8 in.; cargo holds, with space for 3000 lb of baggage, freight or mail, located below the cabin floor; cruising speed of 200 mph with 50 per cent power at 10,000 ft, and a crew of two.

you on ALUMINUM?

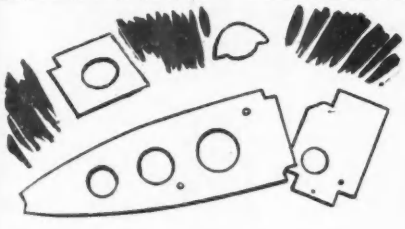
Wire. Cross-sections less than ⅜ inches. Also finished rivets.



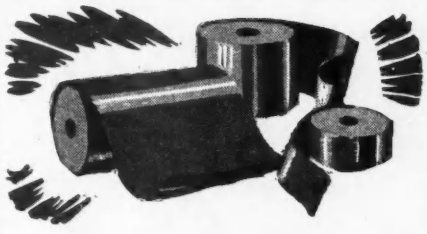
Rod and Bar. Sizes from ⅜ inches to 8 inches for forging and machining.



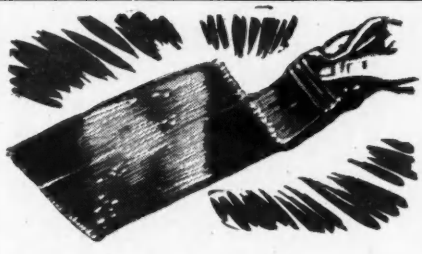
Shapes. Rolled and extruded sections to fulfill individual needs.



Parts. Fabrication at aluminum source saves manpower, plant space, scrap and transportation.



Foil. For years the largest producer of light gauge aluminum for packaging, technical and insulation purposes.



Powders and Pastes. For aluminum coatings.

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12 **Weight Calculator.** Slide rule for determining weights of all commonly used metals.

13 **Sheet.** (Bulletin 22-A.) Specifications, ordering data, etc. 8 pages.

14 **Product Design.** "Reynolds Aluminum, its Important Role in Tomorrow's Products." (Catalog 100.) 16 pages.

15 **Motion Picture.** "A Recital of Faith." The story of aluminum production. 16mm and 35mm. Available to interested groups.

16 **Metal Industries.** Cond. Catalog of Reynolds products and services for Metal-Working Industries. Properties, applications. 8 pp.

17 **Extruded Shapes.** (Bulletin 35-A.) Specifications, ordering data, etc. 8 pages.

18 **Construction.** "Reynolds Aluminum, its Important Role in Modern Engineering." (Catalog 103.) 12 pages.

19 **Architecture.** "Reynolds Aluminum, its Important Role in Architecture." (Catalog 104.) 12 pages.

20 **"Aluminum Progress."** Bi-monthly, non-technical news bulletin of general interest.

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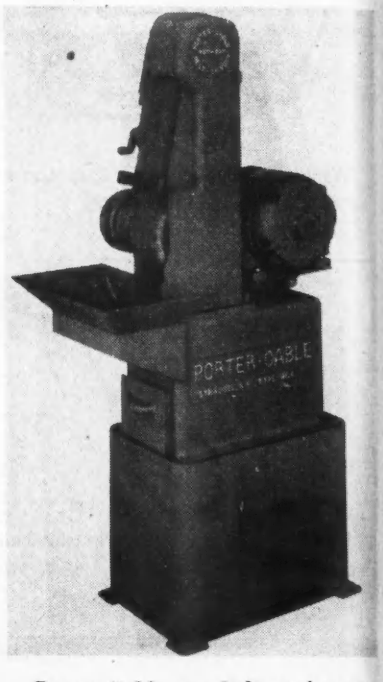
New Production Equipment

(*Continued from page* 38)

The crusher unit is built into the upper part of the base and houses the crushing roller for dressing the grinding wheel with the required multiple grooves for grinding threads. The diamond dresser for the grinding wheel is hydraulically operated and is located adjacent to the crusher unit. Two dial indicators are installed to inform the operator how much the grinding wheel has been reduced in size. One indicator is for the crusher dressing and the other for the diamond dressing. A rigid work rest is mounted solidly on the machine bed. Thread grinding requires unusual features in the work rest. Wedges to give the precise slope to the work rest blade are provided and they greatly simplify set-up requirements. The side blades remain vertical and parallel to each other for any diameter of screw. The machine has been designed so that an automatic hopper-feed mechanism may be attached to the front of the machine bed. This permits an operator to handle several machines, occasionally checking samples of work as they are ground.

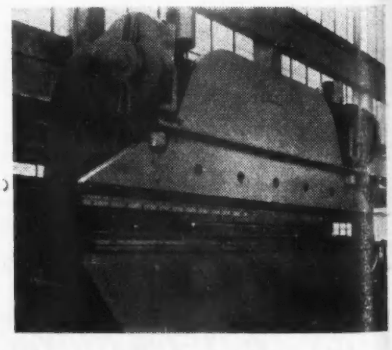
THE advantages of wet belt machining may be applied to line contact grinding and polishing as well as platen machining in a new machine, the WG-4, which has been added to the line of the Porter-Cable Machine Co., Syracuse, N. Y. Heretofore, line contact grinding and polishing were available only in a dry machine also manufactured by Porter-Cable. Wet belt operation is said to eliminate the disadvantages of the dry method, and to result in increased output.



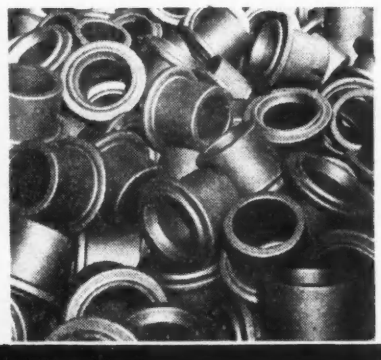
Porter-Cable wet belt surfacer

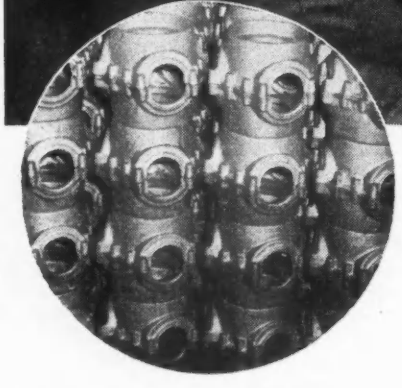
The WC-4 is equipped with a self-contained recirculating system and individual motorized pump. The 4-in. belt is driven by a 1½-hp motor.

Huge Two-Housing Mechanical Press Brake



This press brake, built by the Cincinnati Shaper Co., Cincinnati, Ohio, is said to be the largest mechanical, two-housing press brake in the world. It has a clear span of 20 ft. between the housings, an overall die surface of 30 ft., and is capable of exerting a pressure of 1,000 tons.





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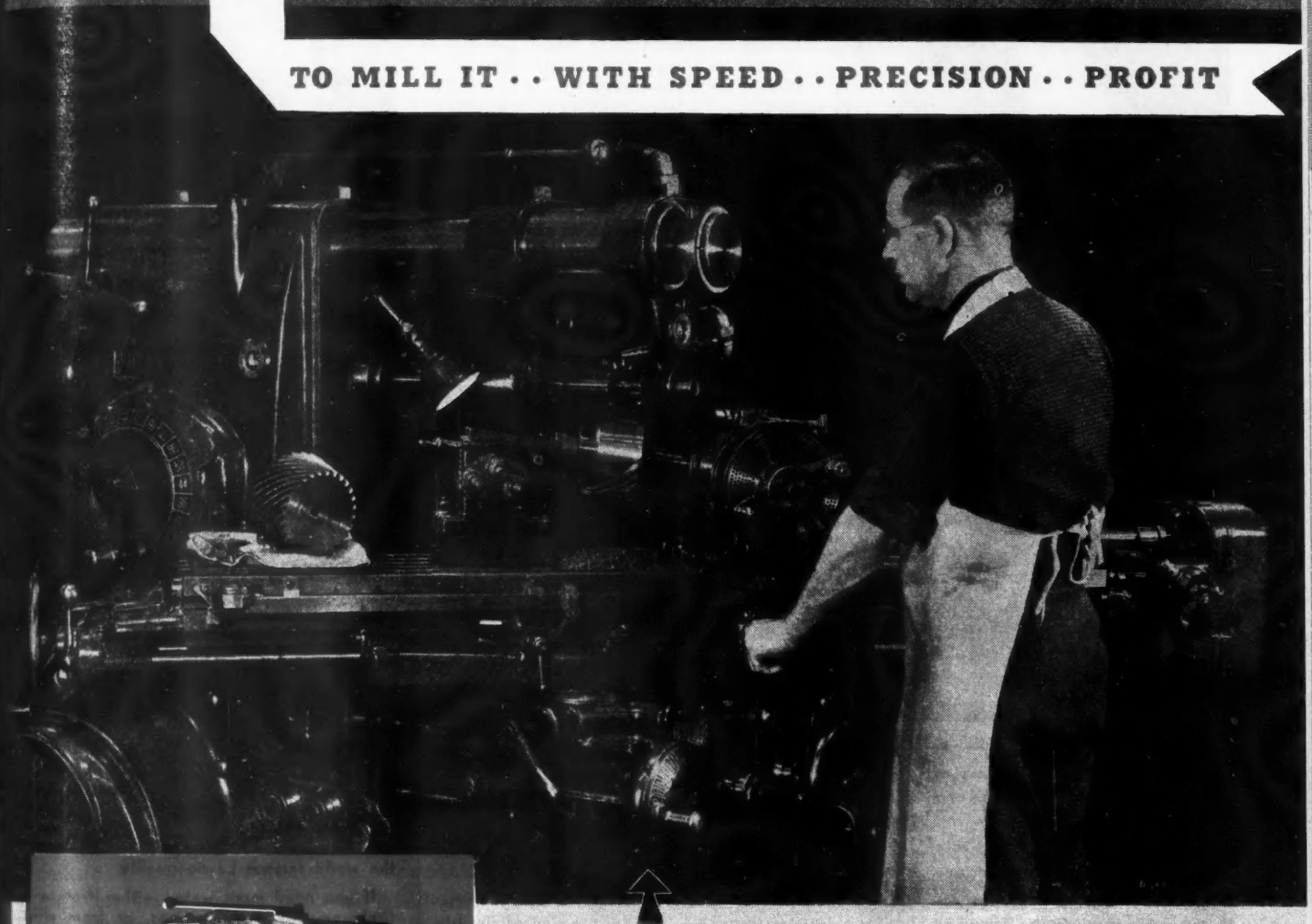

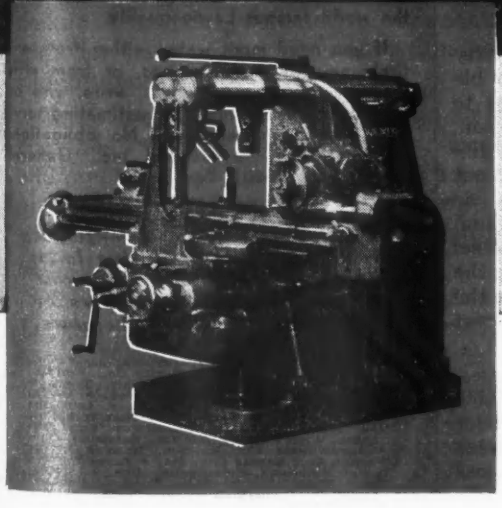

Milling Taper Reamer: in this operation a Milwaukee 3K Universal is milling the flutes in a 20° included angle taper reamer. A low lead attachment is used with a Milwaukee Model K Dividing Head and tailstock for driving, holding, and indexing the workpiece. The space between each flute is measured by less than one turn of the 5 to 1 ratio Milwaukee Dividing Head. A Milwaukee Style B Arbor employing both intermediate and outer arbor supports is used to hold the form cutter.

"When the job is a bit tricky — play it safe — put it on a Milwaukee" — that's what experienced machine-shop men say. The range — power — precision of Milwaukee Milling Machines — their versatility in handling a wide variety of intricate "precision" milling operations with the least time and trouble —has made them the preferred machines wherever metal is milled.

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"CONTROLLED UNIFORM ACCURACY"

American Robot Bomb

(*Continued from page* 35)

so that the entire blast of heated expanded gas is expelled through the discharge duct to give the weapon a forward thrust. After the explosion, air pressure again forces the flaps open and the cycle is repeated at the rate of about 42 times per second. To start the engine, a charge of compressed air is introduced with the fuel and the mixture ignited with a spark plug fed from a storage battery (external supply). Once the engine is started, no ignition is required to keep it running.

The grid consists of 15 grid bars and 16 flapper plates. The flaps are spring steel, riveted onto a cold rolled steel bar. Grid bars are die cast of aluminum. Originally they had been milled, but Ford engineers developed permanent molds to do the job at a great saving in time and cost. Another instance of cutting down production time involved the finishing operation on the facing of the transition unit. Formerly done on a turret lathe, the job now is placed on a Blanchard flat grinder and done in 15 minutes—half the time formerly required. Improved production techniques will cut down time and cost if the program is expanded.

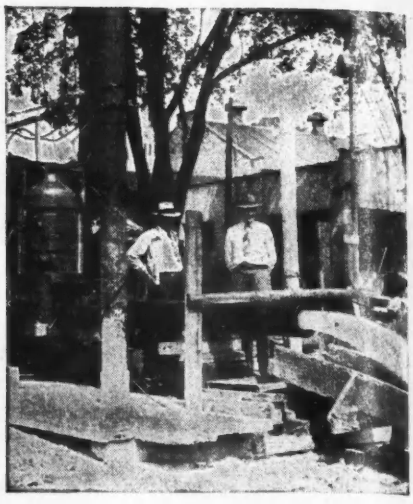
Ford has two developments ready now which will be put into effect if orders increase. One involves the transition unit which currently is made up piecemeal by welding several sections together. A technique has been perfected which will permit drawing it in one piece. The hollow yoke now used in mounting the engine is an involved piece, requiring the welding of tubes and bars. Ford engineers will cast it in one piece as soon as production commitments permit. This method reduces cost about two-thirds and make the yoke three times as strong.

Three of the grid bars carry three fuel jets each. These jets are of double tube construction and are designed to spray the fuel in a whirling motion, which improves the mixture and its distribution. The fuel, generally about 62-ostane gasoline, is fed to the jets under pressure of 40 psi maximum through a copper-impregnated steel tubing system. Fuel flow through the jets is carefully calibrated, with the nine jets being held to within 2 per cent of each other.

In construction of manifold bosses, Ford developed a technique which greatly cuts manufacturing time under that used by the Germans. Whereas the enemy version was a square boss milled on four sides out of solid stock, Ford starts with a rough forging which is rough-ground to control thickness and then coined for sizing and flattening. Under this setup, Ford men say, they could turn out enough of these bosses in a day and a half to take care of a sizable contract.

Delivery of fuel to the jets is governed by a fuel metering unit which contains an altitude pressure compen-

(*Turn to page* 82, *please*)



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Shown above is a system recently completed for a major food manufacturer. Running true to Layne form, this system out performs its guarantee, producing nearly twice as much water as other wells in the same locality. This manufacturer knew what to expect. He already owns four other Layne Well Water Systems, all of which have always given outstanding service. He knows how little it costs to operate Layne Systems, how much water these systems produce and how small the upkeep cost.

Layne is already in postwar work. Many postwar installations are now being made. Others will soon be started. All will be of the world famous Layne quality.

If you need more water, either from entirely new wells and pumps, or from efficiently modernized old ones, write, wire or phone for the planning and estimating services of a Layne engineer. No obligation. Address Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

LAYNE PUMPS — fulfill every need for producing large quantities of water at low cost from wells, streams, mines or reservoirs. Send for literature.

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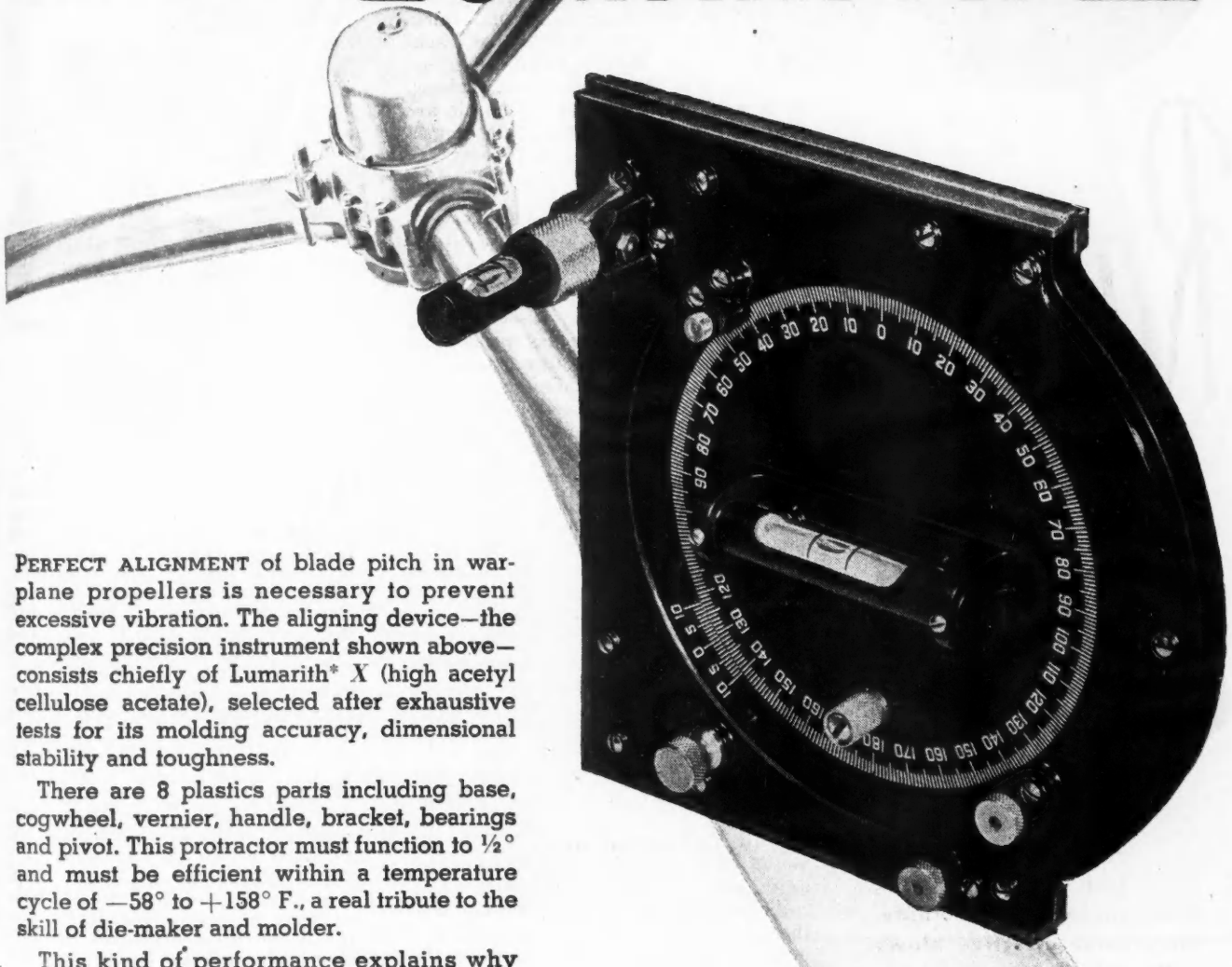
LAYNE

WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

This precision protractor

CHECKS TOLERANCES TO ½°!

AND IT'S MOLDED OF LUMARITH* X



PERFECT ALIGNMENT of blade pitch in warplane propellers is necessary to prevent excessive vibration. The aligning device—the complex precision instrument shown above—consists chiefly of Lumarith* *X* (high acetyl cellulose acetate), selected after exhaustive tests for its molding accuracy, dimensional stability and toughness.

There are 8 plastics parts including base, cogwheel, vernier, handle, bracket, bearings and pivot. This protractor must function to ½° and must be efficient within a temperature cycle of —58° to +158° F., a real tribute to the skill of die-maker and molder.

This kind of performance explains why Lumarith plastics are such favorites with fabricators. The wide range and scope of formulations not only assure materials individualized to the exact characteristics desired for end use, but also for precise dimensional control in molding and machining.

What are your war production problems in plastics? Consult the Sales Development Department of Celanese Plastics Corporation, a division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y.

*Reg. U. S. Pat. Off.

Dropped 60 feet to a concrete floor this Lumarith X propeller protractor was still workable although the metal frame had broken. Note that calibrations are *molded* in, not cut.

Molded by Cruver Mfg. Co., Chicago, Ill.

A Celanese Plastic*

sator to prevent enrichment of the mixture in the more rarefied air at higher altitudes. An air speed compensator increases the fuel flow as velocity increases, keeping the air-fuel ratio uniform at all speeds. The earlier German models did not have the metering device, which accounts for their erratic flight in the early days of their use. At full speed fuel consumption is approximately 2940 lb per hr or 3.3 lb per hp-hr.

Construction of the engine, which has been dubbed by Ford workers as the "flying chimney," is on an assembly line basis. The three main sections are rolled from open-hearth, low-carbon steel approximately 0.109 in. thick. These tubular structures are tack-welded before they start through assembly. The discharge duct is placed on a welding jig and an automatic arc welder runs a seam the full length. The other two sections at present are being hand-welded, as are the joints between sections. The job is progressive after the three sections are assembled, with the venturi, transition unit, grill cowling and other parts installed at successive stations.

Fuselage and wing assembly at Willys also is on a mass production basis. The fuselage proper consists of the tail section, two middle sections, and nose tip. The main sections are subcontracted, and the nose tip, made of spun aluminum to avoid magnetic interference with the automatic compass, is manufactured by Willys.

The tail section carries the automatic pilot, fuel metering unit, and the servo unit which operate the rudders, elevators, and spoilers. The next forward section contains the fuel tanks and two compressed air tanks. The fuel tank differs from the German version in that the bulkheads are rounded for greater strength and capacity. The air tanks also are different, being constructed of two spherical halves of special heat-treated steel welded together, whereas the German weapon has wire-bound containers. The tanks, which supply the air for forcing the fuel into the motor and for operating the control units, are tested for 3000 psi pressure.

An air-operated gyro compass and the "windmill" range control are mounted in the aluminum nose of the weapon.

The sections of the robot bomb are joined by means of bolts running through lugs welded to the reinforced ends of the sections. The two wings are mounted by sliding them over a spar which runs through the fuselage. Wing construction is of the double-rib type common to German aircraft, in which two ribs are placed back to back with the flange on one welded to the lower skin and the upper skin welded to the flange of the companion rib. In this way spot welding can be used at great saving of time since the upper and lower sections of the wing are constructed separately and then fastened together by joining L-shaped flanges at the edge of the wing with spot welds.

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YOU can enjoy better fluorescent lighting service by installing G-E Watch Dog Starters—FS-30 for 30-watt lamps, FS-40 for 40-watt and FS-100 for 100-watt. These manual reset starters eliminate annoying blink and flicker of dying lamps once and for all. Blinking cannot possibly recur because the Watch Dog cuts itself out of the circuit when a lamp reaches the end of its useful life.

Lighting engineers specify G-E Watch Dogs because their life is equivalent to five ordinary starters. Under specified test conditions the FS-40 outlasts an average of ten 40-watt lamps.

Maintenance men prefer G-E Watch Dogs because they reduce lighting maintenance to the easy job of pushing a red button before relamping. Reset it and forget it. It's as simple as that.

Workers appreciate efficient lighting service of fixtures equipped with G-E Watch Dogs. No longer will they be irritated by blinking of dying lamps.

Write for our free bulletin, "How to Use Fluorescent Accessories for Best Lighting Results." Send your request to Section G-453-103, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn.

BUY WAR BONDS AND KEEP THEM

GENERAL ELECTRIC

Clutch Facings and Brake Linings of

Powdered Metal Type

(*Continued from page* 26)

From these molding stations, the molds are transferred to special hydraulic presses which, under a pressure of 20,000 to 22,000 psi, transform the layers of powder into brittle "compacts." When the charge is stripped from the mold after pressing, the compacts are carefully and painstakingly removed from the stack and arranged in piles ready for the next operation.

Now we approach the final stages of the metallurgical procedures. The compacts are placed on cores or backing plates in preparation for sintering and bonding to the core. For this purpose the sandwiches are built up in layers, each core being separated from the other by an insulating metallic disc which resists heat and deterioration under high temperatures.

Sintering and bonding is done in electric furnaces of unusual design, developed by Wellman for the purpose, and is effected at temperatures ranging from 1350 to 2100 F. The furnace is essentially a fixed base structure, served by a removable bell-type top which is transported from one furnace to another for successive heating operations. The plant boasts a great number of these furnaces distributed in various departments. The stacks of sandwiches are supported on the base and are heated externally by means of electric resistors carried in the bell cover.

Pressure for bonding and sintering is applied by a pneumatic diaphragm mounted over the top of the bell cover and is transmitted to the stack by the reaction of the diaphragm on the overhead framework. To prevent oxidation, a reducing atmosphere is maintained within the iron shell enclosing the stacks. After sintering is completed, natural gas is connected to the gas outlet, during the cooling cycle, to make up for any contraction of the reducing atmosphere.

A large part of the plant facilities is devoted to machine shop operations

(*Turn to page* 86, *please*)

Exact Response

At the "business end" of many aircraft controls there are Dole Valves set up to perform exactly as expected—without surprises — without variation from the predetermined response.

The simple fact that they are there means they have passed rigorous tests and won acceptance.

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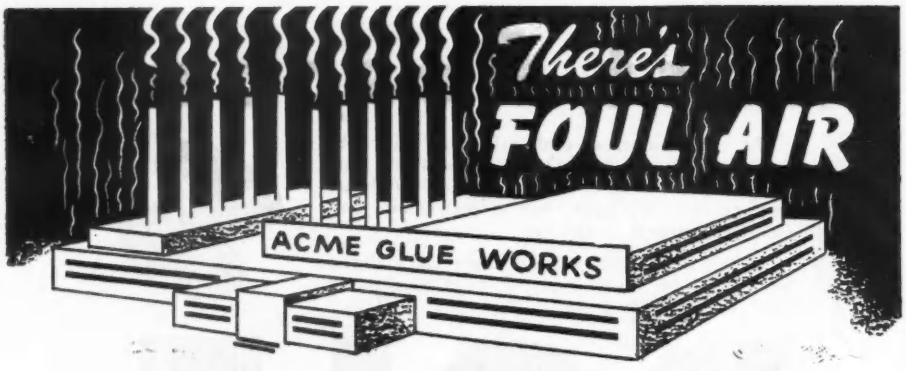


in CRANKCASES too!

Remove it with
DONALDSON POSITIVE Crankcase Ventilation

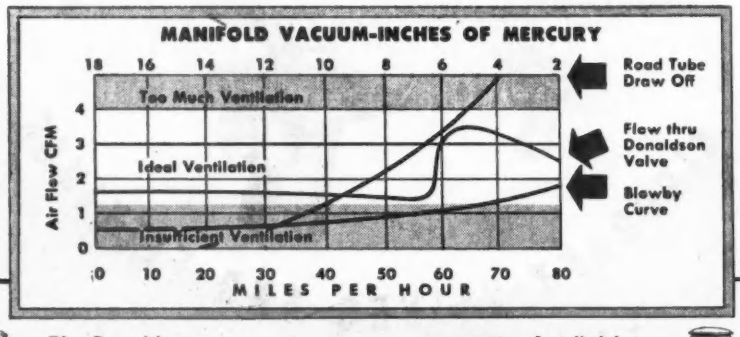
Blowby gases, fuel vapors, and water vapors are present in the crankcase of an engine in operation. Unless they are removed promptly engine troubles develop—hard starting, oil freeze-up, excessive oil dilution, acid corrosion, and lubrication breakdown due to sludge.

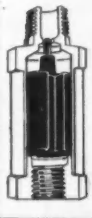
Donaldson Positive Crankcase Ventilation gets at the source of these common engine troubles . . . removing foul air immediately by providing a controlled flow of clean, dry air through the crankcase at all engine speeds, under all conditions. (See Chart below)

The U. S. Army has specified Donaldson Crankcase Ventilation for hundreds of thousands of military vehicles. Every post-war truck, bus or automobile designed for utmost operating economy, greatest engine mileage, and least cost for maintenance, will be equipped with positive crankcase ventilation. Acquaint yourself now with the unique Donaldson System. Manufacturers are invited to write for more information.

DONALDSON CO., INC.
666 PELHAM BLVD. ST. PAUL 4, MINN.

(Graph below showing blowby curve and valve flow is representative of engine of 200 cu. in. displacement)

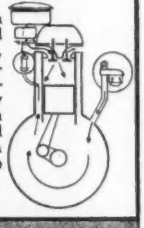

MANIFOLD VACUUM-INCHES OF MERCURY
18 16 14 12 10 8 6 4 2
Too Much Ventilation
Ideal Ventilation
Insufficient Ventilation
Air Flow CFM
4 3 2 1 0
Road Tube Draw Off
Flow thru Donaldson Valve
Blowby Curve
0 10 20 30 40 50 60 70 80
MILES PER HOUR



The Donaldson Metering Valve here cut away to show the simple mechanism, is controlled by intake manifold vacuum and regulates air flow in proportion to blowby.

DONALDSON POSITIVE CRANKCASE VENTILATION

Installed between the crankcase and intake manifold, the Donaldson system employs vacuum to withdraw blowby gases from the crankcase and discharge them into the intake manifold.



for the finish-machining of the sintered parts. Drill presses and saws are used for drilling and slotting operations, while grinding of the finish-bonded discs is performed with a wide variety of surface grinders.

Both table and hand type sand-blasting machines are employed for the sand-blasting of certain cores and some of the finished discs. On the large clutch plates which have a pattern of slots for heat dissipation, the holes for spacing the slots are drilled with multiple-spindle heads, then sawed to suit.

In keeping with mass-production methods, facilities have been so arranged as to provide compact self-contained departments for handling certain elements required in large quantities. A specific example of this is the small ring department which handles the supercharger clutch disc. Operations begin here with the machining of the core from a steel sheet, plating in small electroplating department, then the cycle through a small replica of the setup of weighing benches, molding, pressing, mentioned earlier, and an independent battery of electric furnaces for sintering and bonding. Upon completion of the sintering operation, the supercharger discs proceed along the finish-machining line for turning and grinding operations.

Much of the present growth and importance of this organization stems from the urgency of wartime requirements of the military services. The unprecedented demand for metallic friction linings born of the war has accelerated research and production development to a degree that would have been difficult to equal in a decade of peacetime work. All of this means that the lessons learned in the struggle to satisfy the demands of the war will be used to good purpose in the postwar economy to serve the needs of heavy-duty equipment users—for the brakes and clutches of motor truck and buses, for brakes and clutches and steering clutches of tractors, for machine tools, for industrial equipment of every kind, for marine uses, etc.

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They Are Giving Their All
Now Give Your Little

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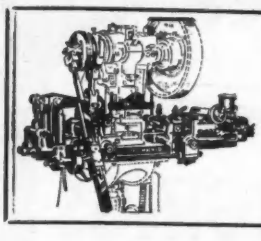

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The first practical answer to large volume, low cost production of ground screw threads is provided by the new LANDIS TOOL Centerless Thread Grinder. It was developed by LANDIS TOOL to meet wartime demands for more and still more production of threaded parts to the closest tolerances. The Centerless Thread Grinder, by a year of actual operating experience since emerging from the LANDIS TOOL laboratory, has demonstrated its worth for today's production needs.

The centerless method of thread grinding employs a formed multiple groove grinding wheel. Work feeds thru continuously. The reduction in work handling operations makes possible unbelievably large production increases. Actual tests on specific parts showed increases in production per day of from *two to five hundred per cent.*

Clean, bright threads are produced on the new LANDIS TOOL Centerless Thread Grinder with the characteristic smoothness of a ground finish. Because the blanks are hardened *before grinding,* less inspection is required and rejects approach the vanishing point because a true thread form is produced by the accurately formed multi-groove wheel. Accuracy of shape and form of the finished thread is maintained free from warpage and distortion errors ordinarily caused by heat treatment.

If you have a thread grinding problem, our engineering department will be glad to investigate the possible application of the Centerless Thread Grinder. Give us full details and we shall be glad to make a recommendation. 22

Landis Tool Centerless Thread Grinder complete with built-in wheel crusher. Convenient controls permit adjustments for different sizes of work, rates of feed and position with respect to wheel.

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No Impending Shortage of Brake Fluid

Reports of an impending shortage of hydraulic brake fluid at the distribution level because of a lack of shipping containers have proved to be unfounded in fact through an investigation made by the Automobile Manufacturers Assn. The rumors apparently were based on the current critical situation in tin. The survey indicated, however, that brake fluid companies in general are in good shape so far as a supply of containers is concerned and that no difficulty on this score is expected. It also showed that three of the chemicals used in the manufacture of brake fluid are under limitation orders, but that they are in good supply.

Metallurgy of Foreign Materiel

(*Continued from page* 33)

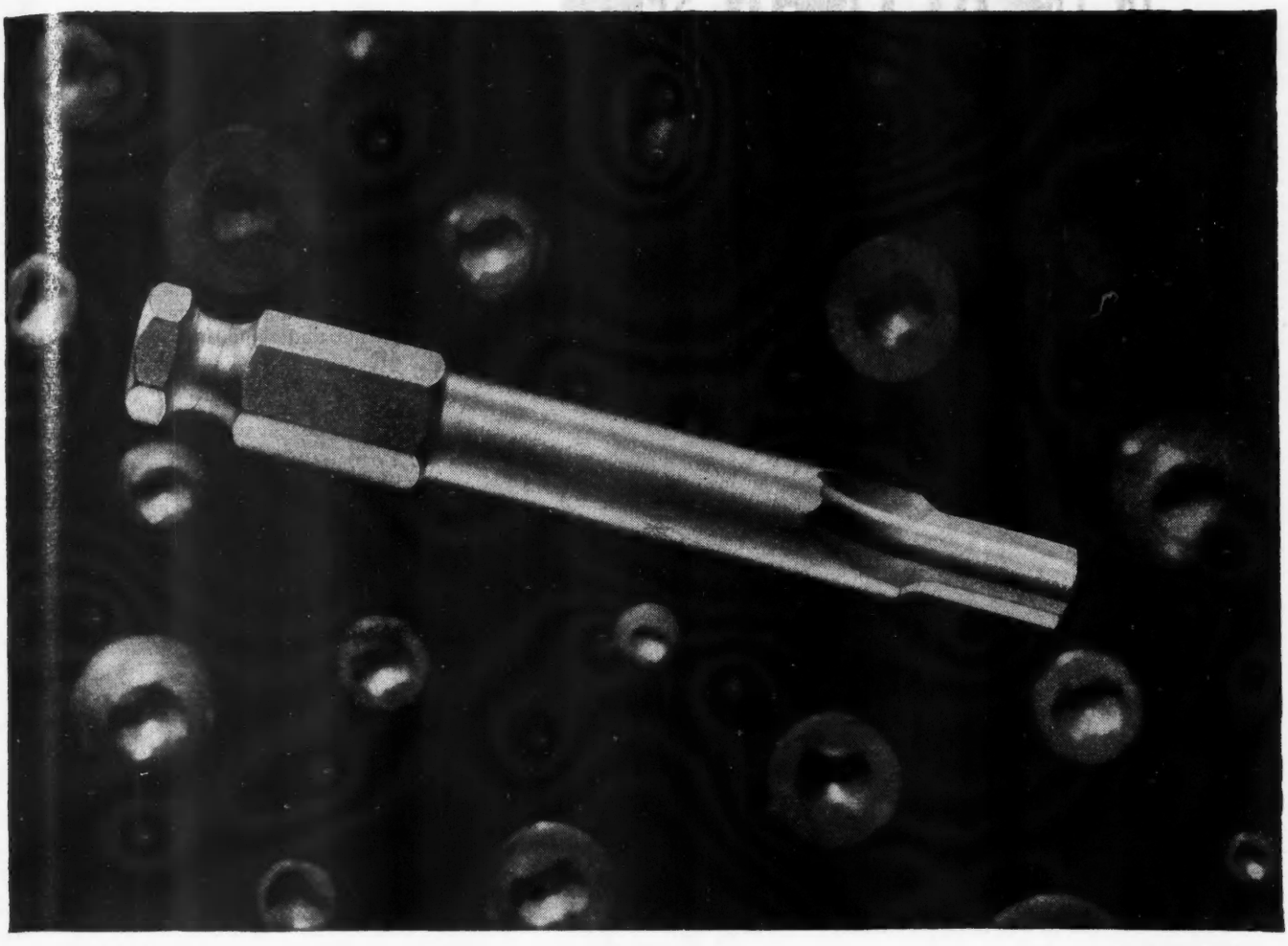
intake valves are interchangeable, but in view of the present chromium condition it is not likely that this practice will be continued in the future. Gears were not case hardened but heat treated to a hardness of about 50 Rc. This practice leads to an extravagant use of alloys, but may be necessary because of limited metllurgical facilities. In this connection, there has been very little use of induction and flame hardening processes in equipment so far examined. Light alloys were used extensively; the cylinder head, crankcase and final-drive housing and miscellaneous components, such as floor plates, being made from aluminum-magnesium alloy.

The 1½-ton cargo truck is almost an exact copy of the 1939 Chevrolet. It weighs approximately 5500 lb and has a payload capacity of 3300 lb. The power plant is a six cylinder, valve-in-head, water-cooled engine with a maximum rating of 78 hp at 3000 rpm. The maximum speed is 45 mph and the radius of action is approximately 200 miles. It is apparent from a review of the chemistries of the cargo truck parts that the Japanese have copied American metallurgical practices as well as design principles in this vehicle.

Volkswagen

This is the much advertised "Peoples Car" which Hitler promised to place in every German family's garage. It is a four-wheeled, rear axle drive (only) scout or reconnaissance car comparable in size and use with our Jeep. The engine is a four-cylinder, four-stroke, horizontally opposed type. A maximum speed of 50 mph and an average of 30 mpg of gasoline can be obtained. It is light in weight (1600 lb) and has a central tubular frame with each wheel independently suspended on torsion bars. The transmission and differential are made as one unit which is flanged to the engine, and this assembly is mounted between two prongs formed by the

(*Turn to page* 92, *please*)



How Many Thousands of Screws Per Bit?

CLUTCH HEAD users have the answer to this question . . . for that is how they measure the economy and efficiency of screw driving on their assembly lines.

The explanation of this unequalled "high-score" driving is simple. It lies in the ruggedness and design of the Type "A" Bit. This ruggedness is self-evident and is made possible ONLY by the mating design of the Clutch recess. This means stamina to stand up through a longer driving spell, free from tool change interruptions . . . speeding up the production tempo and rolling up the record of thousand upon thousand of extra screws per bit.

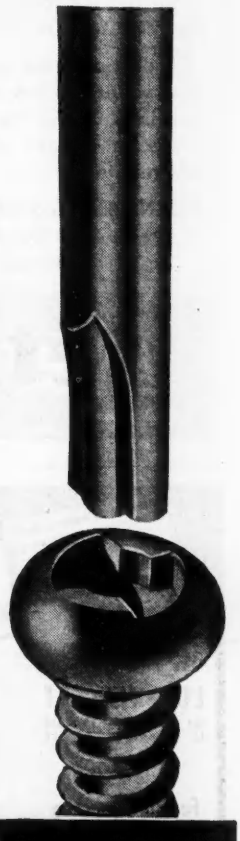
Note, too, that the driving score of this bit is multiplied time and time again because it may be repeatedly restored to original efficiency by a 60-second application of the end surface to a grinding wheel.

Other special features incorporated in CLUTCH HEAD *Screws contribute importantly to greater safety, higher production, and lower costs. We invite your personal investigation of these and will send you,* BY MAIL, *package assortment of* CLUTCH HEAD *Screws, sample Type "A" Bit, and illustrated Brochure.*

Being operative with an ordinary screwdriver or any flat blade of reasonably accurate width, this is THE ONLY MODERN SCREW *that simplifies your field service problems.*

CLUTCH HEAD · SCREWS ·

Note the straight-walled Clutch matched by straight-sided driver for square engagement, eliminating "ride-out" tendency with hazard of slippage as set up by tapered driving.



UNITED SCREW AND BOLT CORPORATION

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frame in the rear of the vehicle. (For a detailed description see the April 15, 1944 issue of AUTOMOTIVE AND AVIATION INDUSTRIES.)

Industries

From an over-all point of view, the phosphorus and sulphur content of carbon and alloy steels is low, averaging less than 0.040 per cent. The comparatively-low alloy residuals are indicative of the German efficiency in scrap segregation and remelting practices. There are two exceptions—the spur gear in the main shaft assembly and the spline shaft and driving pinion, in which the nickel content was between 0.30-0.40 per cent. There are no nickel requirements in the specifications, but in view of the otherwise exceedingly good control over residuals, it is believed that a deliberate modification was made in these instances.

Alloy steels used were confined to grades restricting the alloying elements to manganese, silicon, chromium and molybdenum. The last was used to a greater extent in this vehicle than in others of later production, indicating diminishing stock piles and wider acceptance of substitute grades. It is also possible that parts or components were made from molybdenum steels at an earlier date and assembled later.

Careful checks for boron were made on steels of high hardenability but no indications were found. One of the main shaft spur gears had 0.02 per cent vanadium which might indicate the use of boron, but which could not be found by spectrographic analysis.

The selection of steels and processing methods for the various components represent sound metallurgical practices. Thus, in the case of bearing steels, 52100 composition is used for the inner race, balls and outer race. Races are made from seamless tubing or bar stock, while balls are forged. Heat treatment and resultant hardnesses closely match practices in this country. Gear practice for the more highly-stressed gears of the transmission assembly and the main shaft sub-assembly differs in that medium carbon steels (0.35-0.45 C) are carburized to a depth of 0.010-0.025 in.

(*Turn to page 94, please*)

Where dependability is a "must," where you need strength and stamina and efficiency that can be taken for granted—in the KEY MAN spots, rely on Aetna Bearings. Built into them are the toughness and enduring efficiency that are marks of champions.

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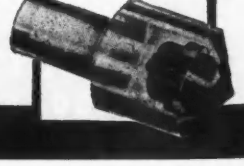

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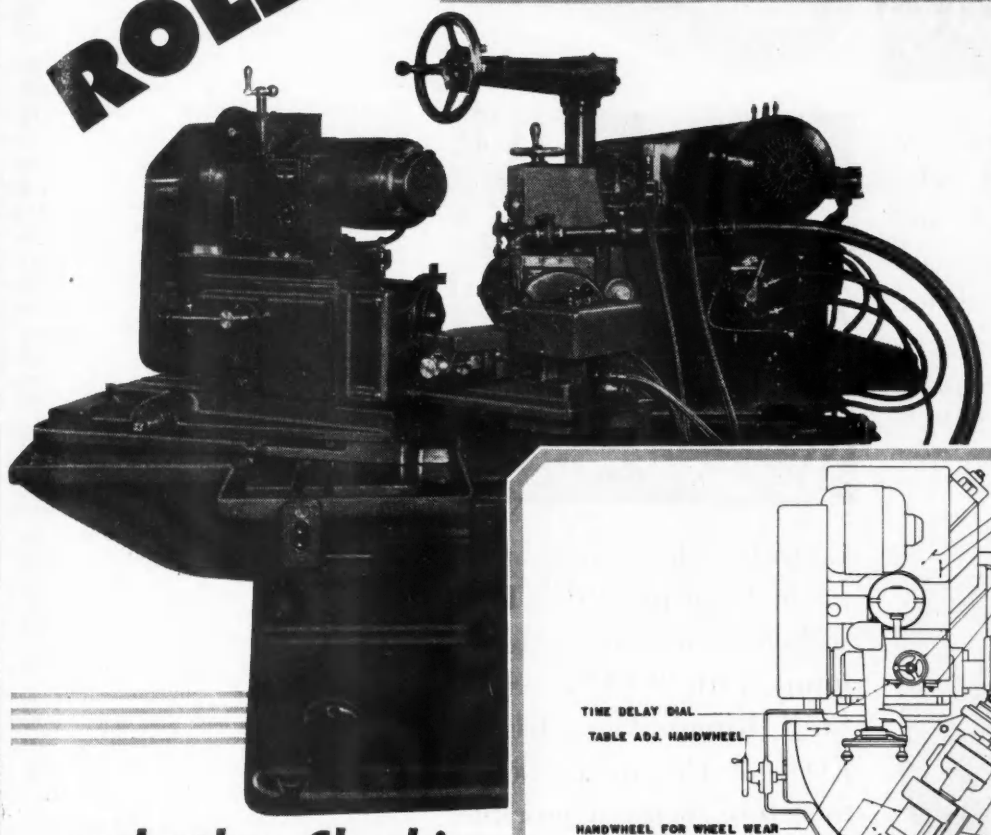

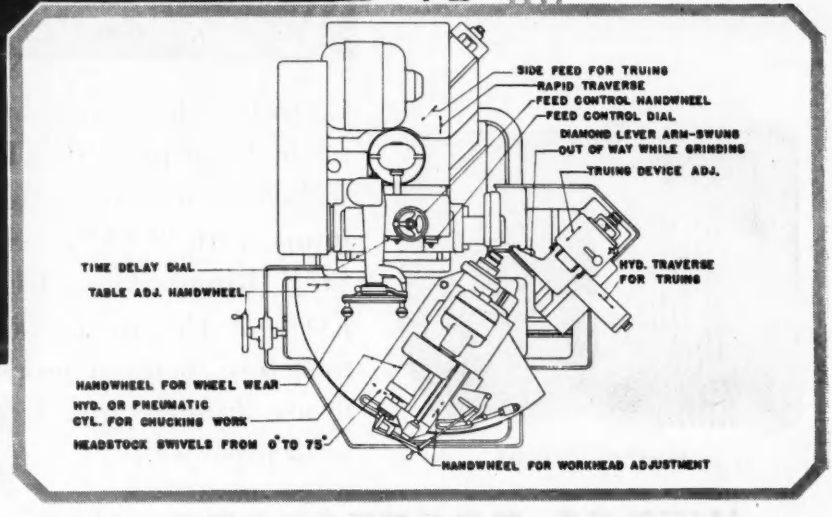
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The Fitchburg Roller Bearing Race Grinder is completely automatic. By pressing a single button the wheelhead goes through its standard automatic cycle — rapid traverse to the work, proper grinding feed, spark-out time, and rapid return. Work is held to limits of .0002" in production.

The workhead can be arranged either hydraulically or pneumatically for collet clamping or other chucking devices.

In this taper grinding application, the wheelhead is mounted on a 45° slide for trueing. The trueing device is mounted on the side of the base parallel to the wheelhead, and is hydraulically operated for trueing, with micrometer adjustment for positioning.

For grinding roller bearing races a Fitchburg grinds them faster and more accurately than other methods. A leading American manufacturer reports enthusiastically on the quality and low production cost of this machine. Write us today for complete information.

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Many don't realize how easy it is to protect valuable parts, threaded and not threaded, by using WEDGE Protectors. Damage that often causes serious and costly delays can be avoided by using WEDGE Protectors. Write for details.

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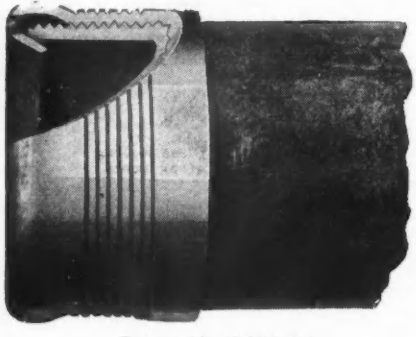

Patent No. 2,156,169

Considerable savings can be made by using LIGHTER walled pipe and welding joints with WEDGE Split Chill Rings. They REINFORCE the joints and, therefore, make it possible to use thinner pipe. If you weld pipe, write.

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Use WEDGE Chill Rings-Thread Protectors

and subsequently quenched from the A-A3 range, followed by low temperature tempering. This produces core hardness values in the range of 40/50 Rc which is somewhat higher than commonly used here. The use of light cases on medium carbon steels increases the life materially and this practice is consistent with the latest thinking of our automotive metallurgists. The fact that every gear in the vehicle was carburized and all but two were made from medium carbon steels indicates their general acceptance of this practice.

The exhaust valves were made from silchrome type steel, but the analysis of the intake valves is puzzling. These use 1.70 per cent carbon, 12 per cent chromium steel, whereas it is common U. S. practice to use SAE 3140, 4140 or 8640. As an explanation, it is believed that this analysis was used as a matter of expediency, probably to utilize frozen or diverted cutlery steel. The intake and exhaust valves were dimensionally interchangeable and both had the heads hot-upset with the tip ends hardened by localized heat treatment.

Each cylinder of this air-cooled engine has an individual finned-block made from unalloyed gray iron. Micrographs indicate unusually sound casting quality and the fins to be fine grained with uniformly-distributed small graphite flakes. The body is essentially pearlitic with coarser interlocking graphite flakes.

The rear axle shaft is made from a medium carbon chrome-molybdenum steel bar which had one end hot-upset to fit into the universal joint. The shaft was gradiently-quenched, obtaining a hardness of Rc 28-34 on the shaft and Rc 45-48 on the tongue. It appears that the cooling rate was not rapid enough to obtain optimum hardening.

One of the most interesting nonferrous parts is the sand-cast magnesium alloy transmission case. The use of magnesium for such purposes is uncommon in this country. The Germans apparently used it because of its ready availability and to contribute to the light weight of the vehicle. The casting was given a dichromate treat-

(*Turn to page* 98, *please*)

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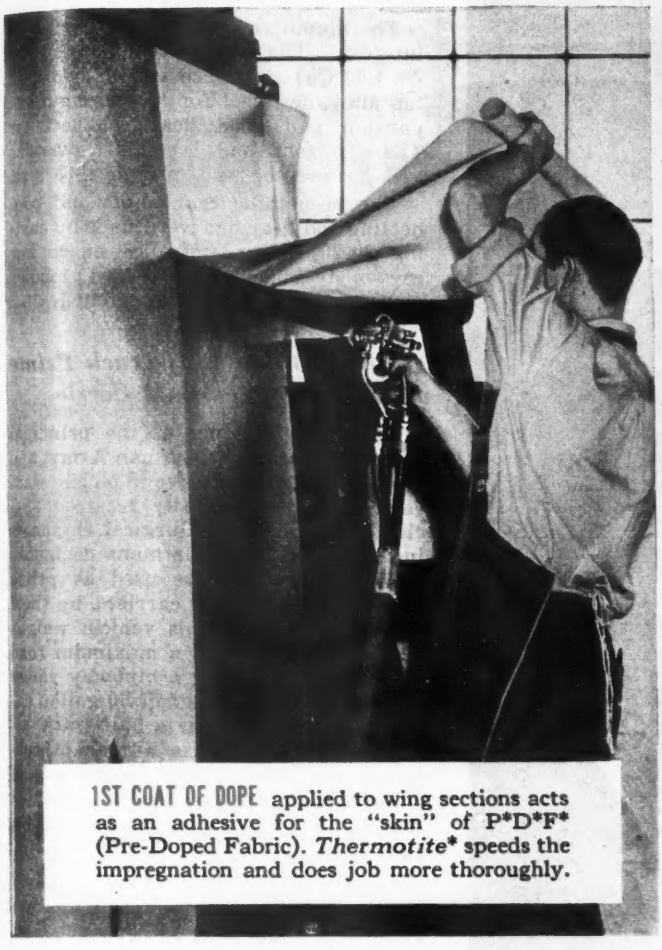
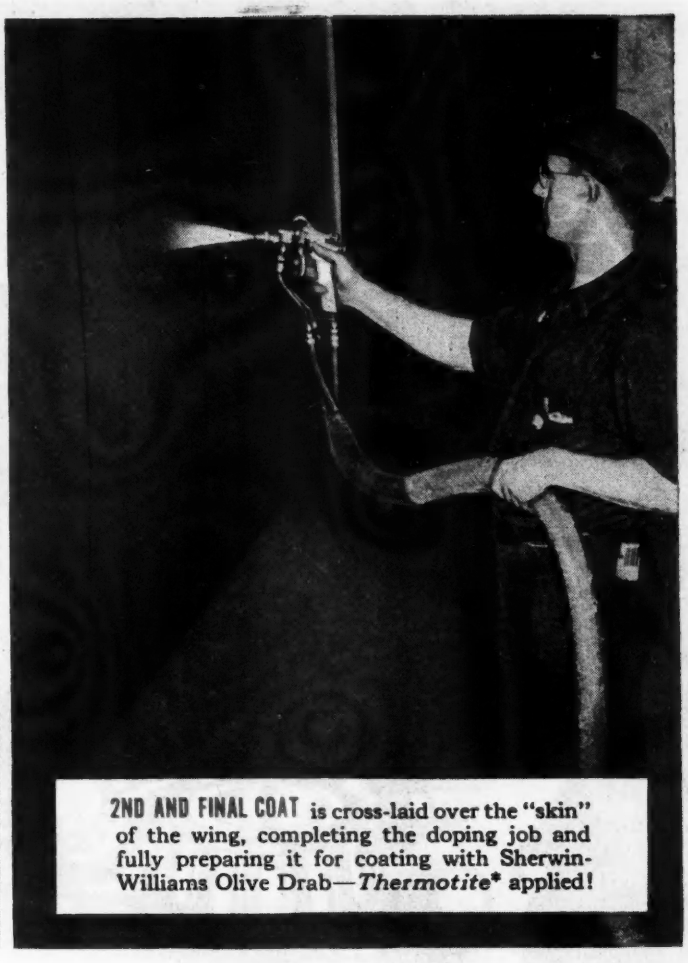


1ST COAT OF DOPE applied to wing sections acts as an adhesive for the "skin" of P*D*F* (Pre-Doped Fabric). *Thermotite** speeds the impregnation and does job more thoroughly.



2ND AND FINAL COAT is cross-laid over the "skin" of the wing, completing the doping job and fully preparing it for coating with Sherwin-Williams Olive Drab—*Thermotite** applied!

THERMOTITE* PROCESS

slashes production time on new WACO troop-carrying glider!

• Only two coats of dope required! Production nearly doubled! That's the big news to come out of Waco Aircraft's application of *Thermotite** in the manufacture of the new CG-15-A troop-carrying gliders!

On fuselage, tail and wing structures, tapes are applied with Sherwin-Williams cold dope over P*D*F* (Pre-Doped Fabric) and are followed by a cross-coat of hot dope applied with the *Thermotite** unit. The doping job is completed with a single coat of Sherwin-Williams Olive Drab fed through the *Thermotite** machine. The body of the glider is ready for assembly.

The wings, built of precisioned plywood, first go through a sealing process. A coat of Sherwin-Williams hot dope is then *Thermotite**-applied... forms a perfect adhesive for the "skin" of Pre-Doped Fabric. A cross-coat of clear hot dope and a single application of Olive Drab follow.

Here's another example of how *Thermotite** eliminates need for thinners and effects revolutionary savings in time and labor. Want complete details? Just write today to The Sherwin-Williams Co., Cleveland 1, Ohio.

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Hoover, the Aristocrat of Bearings, are of the Super-Conrad Deep Groove Type employing the largest size and greatest number of balls. This type of bearing, plus the added advantage of Hoover's exclusive honed raceways has been proved, by actual test, to be the most universally dependable for the varying conditions of load and speed under which modern machines operate.
HOOVER
BALL AND BEARING COMPANY, ANN ARBOR, MICHIGAN

ment to inhibit corrosion.

The aluminum alloy piston is also of interest. The composition (12 Si, 87 Al, 1.03 Cu) is a German standard piston alloy, designed for low thermal expansion and good heat conductivity. These pistons had been cast oversize and hot-pressed and machined to size.

The bi-metallic crankshaft and connecting rod bearings were made by casting 80-20 copper-lead alloy on to low carbon steel backing. The lead globules were small and evenly distributed.

German 8-Ton Half-Track Prime Mover and Personnel Carrier

This vehicle is one of the principal prime-movers of the German Army, and because of its importance to mobile warfare, it has undoubtedly received special design and metallurgical engineering attention. The Germans designate half-tracks, which are used as prime movers and personnel carriers, by their towing capacity. This vehicle weighs 12.7 tons, loaded, has a maximum road speed of 35 mph and a highway range of 155 miles, using its full 50 gallon capacity. It is known as a half-track, although it actually has a track three-quarters of the over-all length. It is powered by a six cylinder liquid-cooled Nordbau engine developing 140 bhp at 2600 rpm.

As in the Volkswagen, most of the alloy steels are of the chrome-manganese and chrome-molybdenum types. Contrary to the Volkswagen chemistries, several nickel alloys are used. The main shaft is made from Krupp analysis and even though it is heavily loaded and highly stressed they have apparently used higher alloy content than needed. The 4.45 per cent nickel is extravagant and compares favorably with German prewar conception of alloy steels. The analysis of this part has a calculated hardenability D.I. factor of about 9, which can be met with a lower alloy content, such as German chrome-molybdenum-vanadium. The D.I. factor appears too high for a section of approximately three inches diameter, and the fact that there have been but few instances of excessive use of critical al-

(*Turn to page* 100, *please*)

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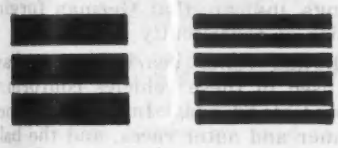
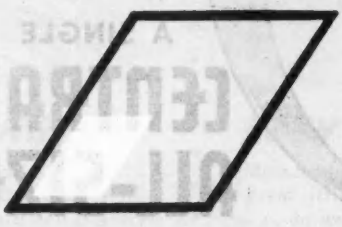
Here's How HIGH-SOLIDS Lacquers Cut Finishing Costs

It's not the cost per gallon that determines finishing costs—more important to consider is the finishing cost per unit!

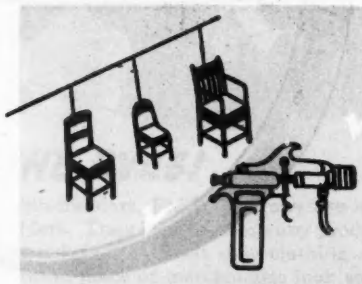
High-solids lacquers mean thicker, fewer coats and many other savings that cut production costs drastically. Here's how:



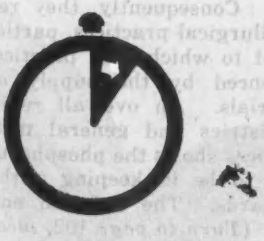
High-solids nitrocellulose lacquers deposit thicker films at spraying viscosity, giving you the same finish with fewer coats.



You save valuable floor space with high-solids lacquers. The fewer number of coats, the smaller the area needed for finishing and work in process.



It's easy to apply high-solids lacquers by any of the usual commercial methods . . . spraying, flow-coating, tumbling, dipping, or roller-coating.



Nitrocellulose lacquers are still the fastest-drying finish . . . in minutes at room temperature. No expensive baking equipment is needed.

One of lacquers' biggest advantages is the ease with which any scratches or imperfections in the finish can be retouched or repaired.

Ask your supplier for complete details. Hercules makes no lacquers . . . concentrates on production of highest-quality nitrocellulose.

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CENTRAL
ALL-SIZE
HOSE CLAMP

SERVES OVER 100 DIFFERENT HOSE SIZES

The *Central ALL-SIZE Hose Clamp*, like the Water Buffalo, is not concerned about size . . . for it serves over a hundred different hose sizes. The standard length, for example, serves any hose from 1" to 3" O.D.

Thus the *ALL-SIZE* eliminates the need for different size hose clamps. And . . . it is powerful enough for all production and service requirements; is easiest to use in hard-to-get-at-places; has fastest clamping action; goes on or off in a jiffy, without disconnecting the hose line; has plenty of take-up, even on synthetic hose; is rustproof, leakproof, self-locking; can't strip or loosen . . . *ALL-SIZE* Clamps are standard for U. S. combat vehicles.

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CENTRAL EQUIPMENT CO. 900 S. WABASH AVE. CHICAGO 5, ILLINOIS

loys may indicate that this particular case was one of expediency.

The outer race of the universal joint also contains high nickel, the analysis being comparable to SAE 3312. It would seem that this part also uses too much in the way of critical alloys and that a grade comparable to SAE 4315 would suffice.

It is evident that chromium is the principal alloying element in German alloy steels and is usually combined with manganese or molybdenum. Gear steels are chrome-manganese or chrome-molybdenum types, and, contrary to the gear practices employed in the Volkswagen, low carbon carburizing grades are used.

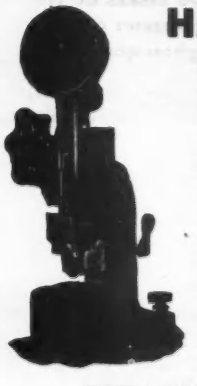
The crankshaft is made from chrome-molybdenum steel to which is added one-half per cent nickel. Micrographs of No. 3 and No. 4 throws indicate that a considerable amount of machining was done, but more particularly, the quality of the induction hardening of the bearing areas; the hardened zones were not carried into the fillets. Also of interest is the tack welding of a nitrided timing gear to the crankshaft. Micrographs of many cross-sectioned gears, and other forgings, indicate that German forging practice is consistently good.

Ball and roller bearings that have been used in these vehicles conform to accepted standards. In each instance, the inner and outer races, and the balls or rollers were made from steels comparable with SAE or NE 52100 grades. Bearing assemblies have been marked as being made in Sweden, Italy and Germany.

German Heavy Duty Engine and Transmission

This engine and transmission are of more recent design and production, estimated to have been produced in late 1942. Consequently, they reflect later metallurgical practices, particularly the extent to which such practices may be influenced by the supply of critical materials. An over-all review of the chemistries and general metallurgical practices shows the phosphorus and sulphur to be in keeping with accepted standards. The data do not indicate

(*Turn to page* 102, *please*)



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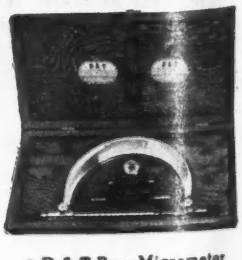

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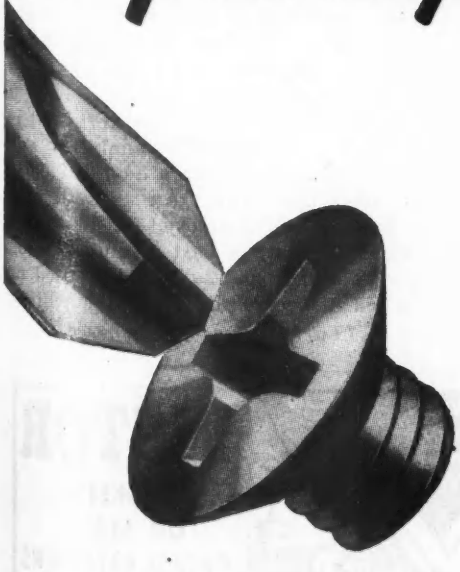

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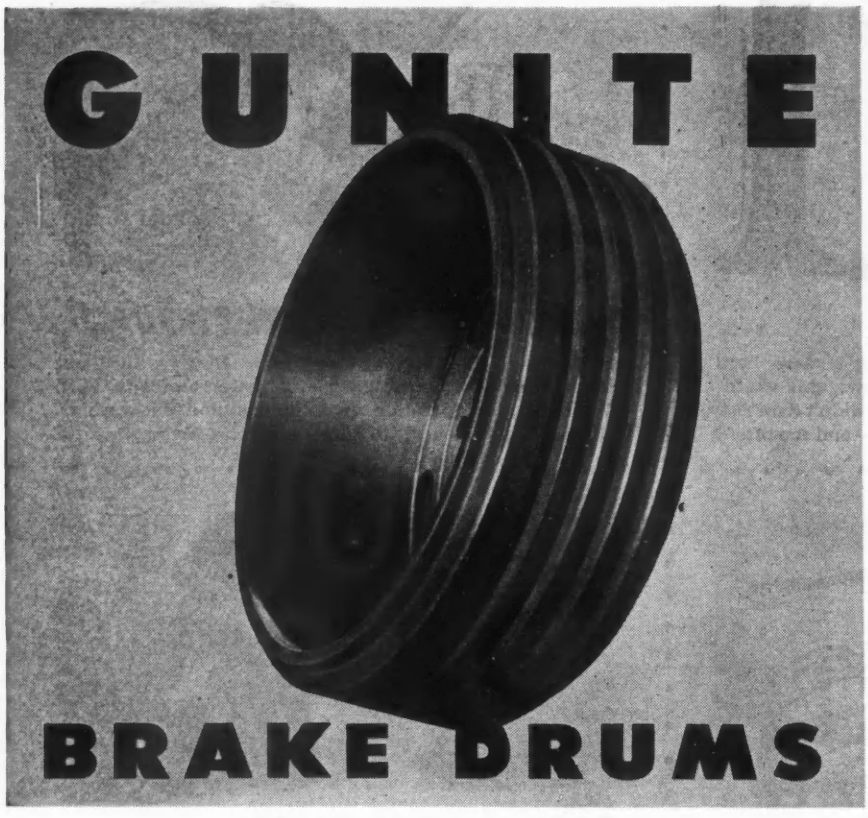

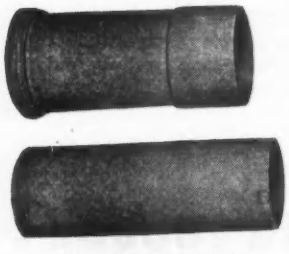

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that German steel-making practices have deteriorated since the time of the manufacture of the Volkswagen. It is also apparent that scrap segregation is strictly enforced. Residuals in alloy steels are slightly higher than in carbon grades, but the over-all average will approximate 0.08 Ni, 0.07 Cr and 0.02 Mo.

As contrasted with the chemistries used in the Volkswagen and the halftrack, there has been almost complete elimination of ferro-alloys critical to German supply. Chrome and manganese have been used to replace the previously-used molybdenum. Nickel has entirely disappeared, except for one or two instances in nitriding steels. Hardenability requirements have been met by the increased use of manganese, chromium and more drastic quenching in heat treatment. This is a complete reversal of prewar German metallurgical thinking and shows the manner in which a difficult supply situation was handled.

The gear summary also shows that carburizing grades are used for all cased gears, conforming to the practice used in the halftrack, but differing from that used in the Volkswagen. However, the gears were carburized rather deeply and quenched out to develop high core-hardness values.

The crankcase is rather large in diameter and operates at a speed of about 3000 rpm, which imposes heavy loads on the bearings and throws. The bearing areas have been induction hardened. The hardened areas are not as well controlled as in the half-track crankshaft and the quality would be considered marginal in this country. The crankshaft is made from essentially SAE 1345 steel with small additions of chromium (0.14 per cent) and vanadium (0.04 per cent).

The camshaft is made by forging bar steel of SAE 1015 analysis and carburizing all over to a depth of 0.035 in. after machining. An unusual type of processing is employed in making the camshaft gear. A cast medium carbon steel blank is partially hot-pressed or forged at the tooth rim and machined

(*Turn to page* 106, *please*)

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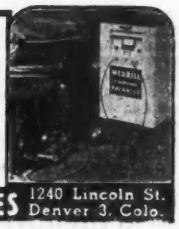

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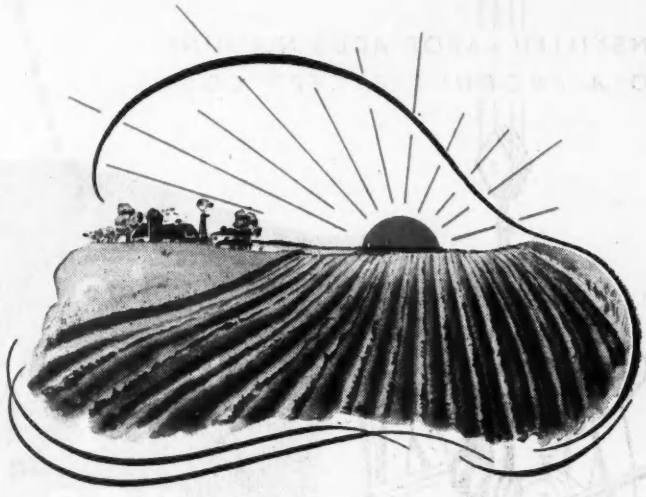

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to size. The gear is normalized after forging, obtaining a hardness of Rc 22-27.

The solid intake valves are made from 0.43 C, low nickel, high chromium steel which would be entirely satisfactory, but the 1½ per cent chromium is apparently higher than needed for service requirements. The exhaust valves are hollow and filled with sodium. They are made from silchrome type of steel bars which are drilled and hot-upset, and after filling the hole in the valve head is sealed off with 18-8 weld metal.

The main shaft and clutch gear assembly is interesting because of the processing method used. The main shaft is made from 0.30 C-manganese steel (SAE 1036) and the clutch gear from 0.44 C-chrome-manganese steel forgings, and, after machining all over, the two are welded to form an integral unit. Although complete penetration through the weld joint has not been obtained, it appears that the weld area has sufficient strength to meet the stress requirements. The welded areas have been machined and the assembly straightened after welding.

The torsion bar is made by hot-upsetting bar stock of carbon-chrome analysis. However, the hardenability has been materially increased by a vanadium addition of 0.05 per cent. A small quantity of nickel somewhat above residual limits is also present. The calculated D.I. is approximately six, which is about right for the 2½ in. cross section. A measure of the effectiveness of heat treatment is indicated by the 148,000 psi yield strength (0.1 per cent offset) at the surface and 131,000 psi at the center of the bar.

Aluminum alloy (12 per cent Si) castings are used for the engine block, pistons, crankcase, timing case and intake manifold. Cast-iron, cylinder-liner inserts are used and the cylinder head is also cast iron.

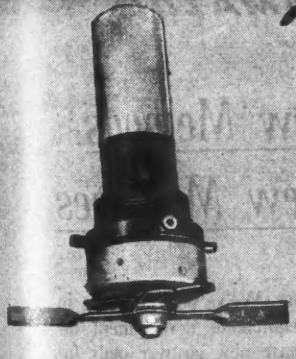
Hughes Announces Postwar Feeder Airliner

A postwar feeder airliner has been announced by the Hughes Aircraft Co., Culver City, Cal. This new plane will embody all the innovations for an aircraft to be adaptable to feeder line work. Planes will be produced in quantities when the facilities of the plant are no longer needed for war work.

The plane will carry both passengers and cargo. It is a high-wing, two-engine monoplane designed to a gross weight of 18,500 lb, which includes 18 passengers and baggage and 350 lb of cargo. It will be capable of flying on one of its two engines and still maintain altitude.

Since the cruising speed will be 186 mph with a stalling speed of 57.5 mph, the plane will be able to operate in small fields safely and at an economical mileage cost. Mail and cargo pick-ups will be provided.

A New Code for Bushido!



Untold thousands of bombs, equipped with these M103 fuses are being used to knock-out and destroy the enemy whether he be on land or sea.

A Code that the "sons of heaven" never reckoned upon. A Code of JUST RETRIBUTION for treachery—and day after day carrier and land based planes of our Armed Forces are dropping their retributive loads of destruction on Nippon's greatest cities.

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Centerless Grinding Of Screw Threads

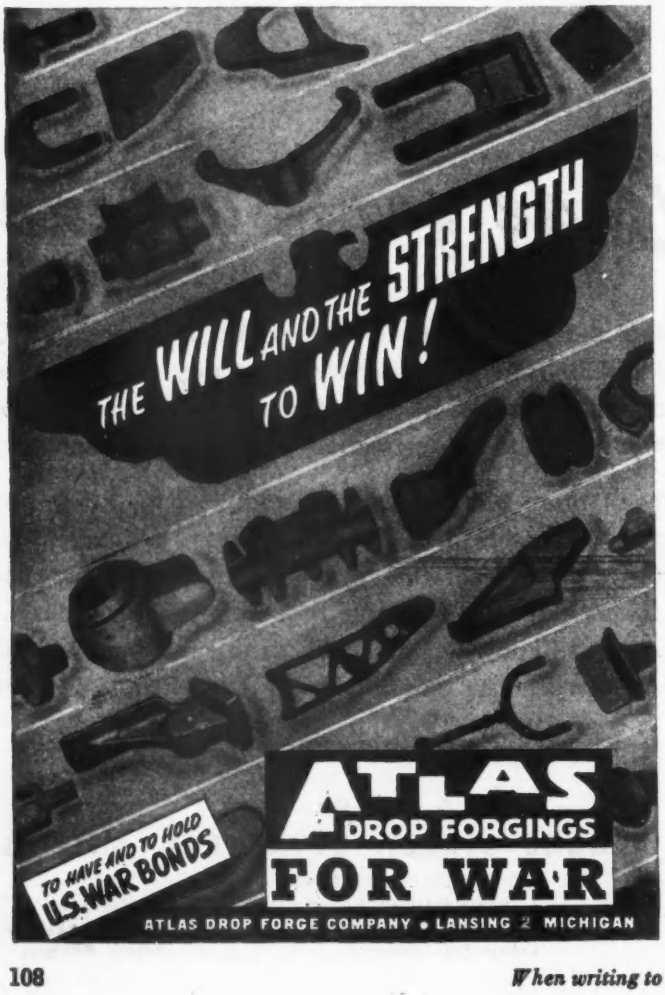
(*Continued from page* 23)

ment as small as .001 in. being possible. Its speed is 1200 or 1500 rpm. The higher speed is used to compensate for wheel wear.

Provision is made for universal movement of the regulating wheel so that it can be positioned to control certain important conditions. As with the grinding wheel, moving it laterally increases or decreases the throat for the various screw sizes and also its position with respect to the stationary work rest blade. The regulating wheel can be adjusted forward or backward as required for the grinding wheel width. It also can be rotated for positioning parallel to the grinding wheel or at an angle if taper work is to be ground.

The most important adjustment of the regulating wheel is the tilting of it (see Fig. 1) to the angle required to provide the desired feeding rate through the throat between the grinding and regulating wheels. As shown in the drawing, the angle at which the screw blank is fed through the machine with respect to the grinding wheel axis is the helix angle of the thread, which determines the screw lead since the helix angle for any standard screw thread is always dependent upon the

(*Turn to page* 110, *please*)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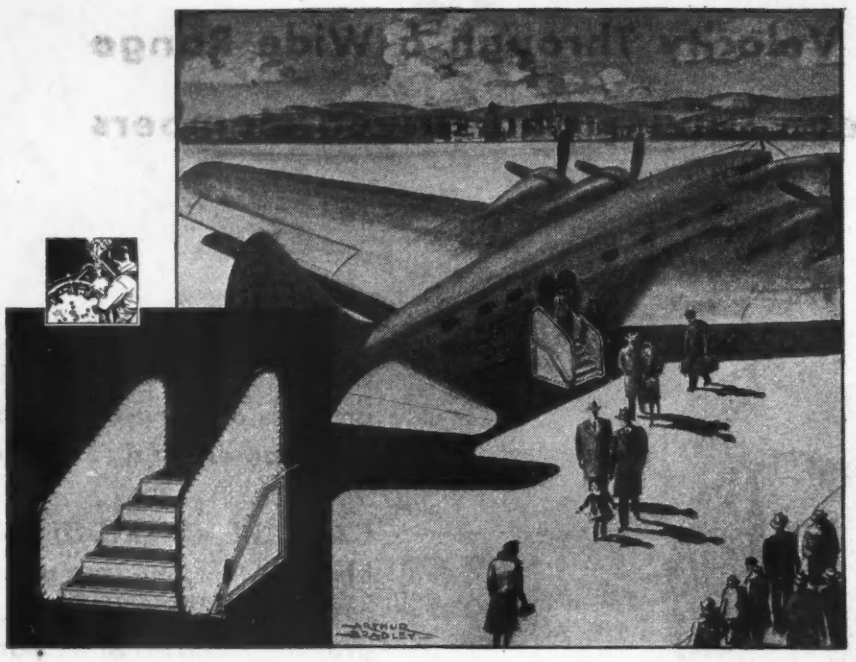
given pitch and basic pitch diameter. Therefore, the slope of the work rest blade is determined by the helix angle of the particular screw thread being ground.

Likewise, since the regulating wheel must assist in rolling the screw through the throat, its axis is tilted downward at the helix angle with respect to the work rest blade angle so that its angle with the grinding wheel axis is double the helix angle. This setup is shown in Fig. 1. The regulating wheel has a speed range of 2 to 96 rpm.

The precision of centerless thread grinding meets the standards for class 3 fit of thread screws, the company states. With ¼-20 screws it is possible to maintain the pitch diameter within a tolerance of .0005 in. Since the screw blank is ground on the major diameter throughout its length, the relationship between the major diameter and the pitch diameter is constant. The lead error can be held to .0005 in. in one inch length, or less depending on the rate of production; in some cases at reduced rates the lead error being held to .0001 in. per inch length. Among the other advantages claimed for screw threads made by this centerless grinding method are a constant major diameter through the length of a socket set screw, exceptionally smooth threads and an accurate thread angle.

Crushing is recommended by Landis Tool engineers as the most efficient method for forming the annular ridges on the grinding wheel face. Fig. 2 shows a crusher. During the crushing operation the crusher is driven at a speed of approximately 150 surface fpm, which has been found satisfactory for crushing a 4 in. wide grinding wheel. Previous to crushing, the grinding wheel face is diamond dressed for truing. After crushing the entrance section of the grinding wheel is diamond dressed to form a chamfer about ½ in. wide to centerless grind the OD of the blanks before threading begins and also to start the ridges on the grinding wheel gradually so that metal removal is distributed across the face of the wheel. The time required to

(*Turn to page* 112, *please*)



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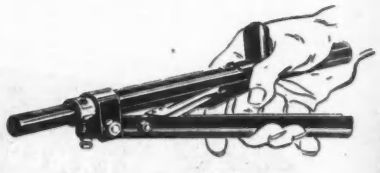
crush wheel, after initial crushing, is about 10 minutes for the complete operation. Centerless grinding forms a rounded root and since the root is dependent upon the crest of the ridges on the grinding wheel, the grain size for the latter is selected on the basis of the root to be ground.

Small, Lightweight Cherry Rivet Gun

A lightweight rivet gun, the G-35, is a recent development of the Cherry Rivet Company, Los Angeles, Cal. Designed for installing Cherry blind rivets in hard-to-get-at blind spots, it is



Cherry rivet gun

operated with one hand and installs the rivet from one side of the job, with a pulling force.

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Willys-Overland Motors, Inc., has produced more than 300,000 jeeps to date. The company has definite plans to enter the postwar market with a modified jeep adapted primarily for agricultural use as a utility vehicle.

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